



FCC Test Report

FCC Part 15.247 for FHSS systems/ CANADA RSS-210

FOR:

Harman Becker Automotive Systems
39001 West 12 Mile Road
Farmington Hills, MI 48331
U.S.A

MODEL #: NTG4 REU
NTG4 REX
NTG4 RE1

FCC ID: QNG-BE2727
IC ID: 6434A-BE2727

TEST REPORT #: EMC_HARMA_005_15.247_rev2
DATE: 2008-11-05



FCC listed:
A2LA
accredited

IC recognized #
3462B

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Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May



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1 Assessment

The following is in compliance with the applicable criteria specified in FCC rules Part 15.247 of the Code of Federal Regulations and in compliance with the applicable criteria specified in Industry Canada rules RSS210.

Company	Description	Model #
Harman Becker Automotive Systems	Automotive Infotainment Head Unit with Integrated BlueTooth for Hands Free Cell Phone	NTG4 REU
		NTG4 REX
		NTG4 RE1

This report is reviewed by:

Lothar Schmidt
 (Director Regulatory and
 Antenna Services)

2008-11-05 EMC & Radio

Date	Section	Name	Signature
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This report is prepared by:

Peter Mu
 (EMC Project Engineer)

2008-11-05 EMC & Radio

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Identification of the Equipment under Test. The CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.



2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	EMC
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Responsible Test Lab Manager:	Lothar Schmidt
Responsible Project Leader:	Peter Mu
Date of test:	2008-2-25 to 2008-2-27

2.2 Identification of the Client

APPLICANT	
Applicant (Company Name)	Harman Becker Automotive System
Street Address	39001 West 12 Mile Road
City/Zip Code	Farmington Hills, MI 48331
Country	USA
Contact Person	Angela Klein
Telephone	248 994 2181
Fax	248 848 9463
e-mail	abklein@harmanbecker.com

2.3 Identification of the Manufacturer

Same as above applicant.



3 Equipment Under Test (EUT)

3.1 Specification of the Equipment under Test

EUT	
Marketing Name of EUT (if not same as Model No.)	NTG4 REU
Description	Automotive Infotainment Head Unit with integrated BlueTooth for Hands Free Cell Phone
Model No.	NTG4 REU
H/W	PV1
S/W	9.xxx
FCC-ID	QNG-BE2727
IC-ID (Industry Canada)	6434A-BE2727

Frequency Range:	2400MHz – 2483.5MHz
Type(s) of Modulation:	GFSK, DQPSK, 8PSK
Number of Channels:	79
Antenna Type:	Built in PCB Antenna
Output Power:	Radiated GFSK: -2.32dBm (0.586mW) Radiated DQPSK: -2.49dBm (0.564mW) Radiated 8PSK: -2.29dBm (0.590mW) Conducted GFSK 4.9dBm (3.09mW) Conducted DQPSK 5.2dBm (3.31mW) Conducted 8PSK: 5.0dBm (3.26mW)

3.2 Identification of the Equipment under Test (EUT)

EUT #	TYPE	MANF.	MODEL	SERIAL #
1	EUT	Harman Becker	NTG4 REU	N/A

3.3 Identification of Accessory equipment

None



4 Subject Of Investigation

All testing was performed on the product referred to in Section 3 as EUT. This test report contains full radiated and contacted testing as per FCC15.247 on the EUT with the Bluetooth module.

During the testing process the EUT was tested on low, mid, and high channels using PRBS9 payload using DH5, 2DH5, and 3DH5 packets, all data in this report shows the worst case between horizontal and vertical polarization for above 1GHz.

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS210. The maximization of portable equipment is conducted in accordance with ANSI C63.4.

The Bluetooth circuitry on the NTG4 REU is electrically identical and has the same RF characteristics with another model, NTG4 RER, which has been approved by the FCC under the FCC ID QNG-BE2726. The manufacturer has declared that except for two resistors on the data communication line all the other component of the Bluetooth circuitry are identical. Therefore all the contacted measurement results, including conducted peak power, carrier frequency separation, 20dB bandwidth, number of hopping frequencies, dwell time, and conducted spurious emissions, from the RER, are applicable to the REU. They are reported here in this report.

The EIRP of the REU has been verified to be not higher than the RER.

All testing conducted on the model NTG4 REU, which is electrically identical with the NTG4 REX and NTG4 RE1 being approved in this application. The same EUT is known as NTG4 REU in the United States and Canada, and will be marketed as NTG4 REX or NTG4 RE1 in other regions.



5 Measurements (RADIATED)

5.1 MAXIMUM PEAK OUTPUT POWER § 15.247 (RADIATED)

5.1.1 LIMIT SUB CLAUSE § 15.247 (b) (1) (2) (3) (4)

Frequency range	RF power output
2400-2483.5 MHz	36dBm EIRP

*limit is based upon antenna gain of less than or equal to 6dBi.

5.1.2 Test Results

EIRP: GFSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T _{nom} (23)°C	V _{nom} VDC	-3.53	-3.50	-2.32
Measurement uncertainty		±0.5dBm		

EIRP: $\pi / 4$ DQPSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T _{nom} (23)°C	V _{nom} VDC	-3.08	-3.55	-2.49
Measurement uncertainty		±0.5dBm		

EIRP: 8DPSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T _{nom} (23)°C	V _{nom} VDC	-2.83	-3.35	-2.29
Measurement uncertainty		±0.5dBm		



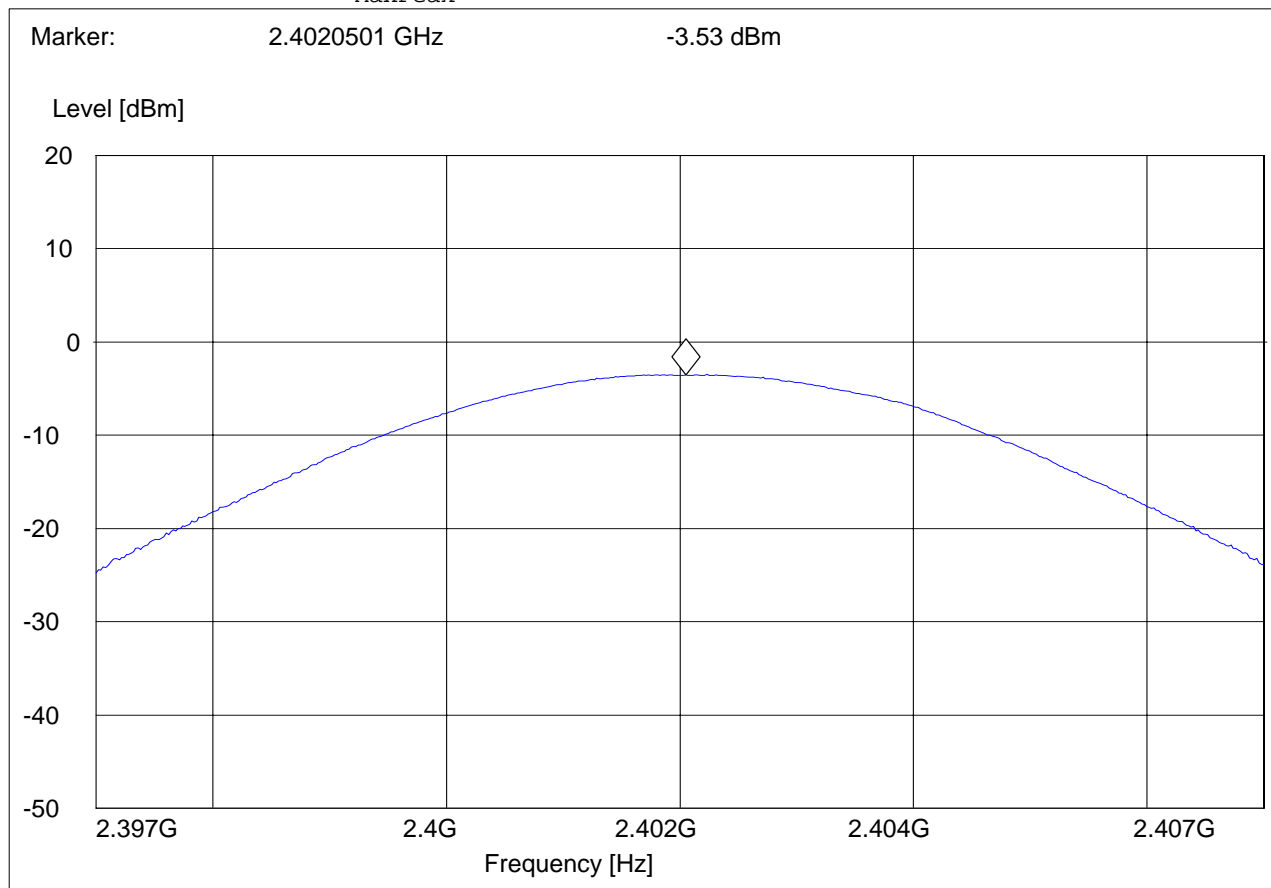
EIRP 2402MHz GFSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT low channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Short Description: EIRP Bluetooth channel-2402MHz





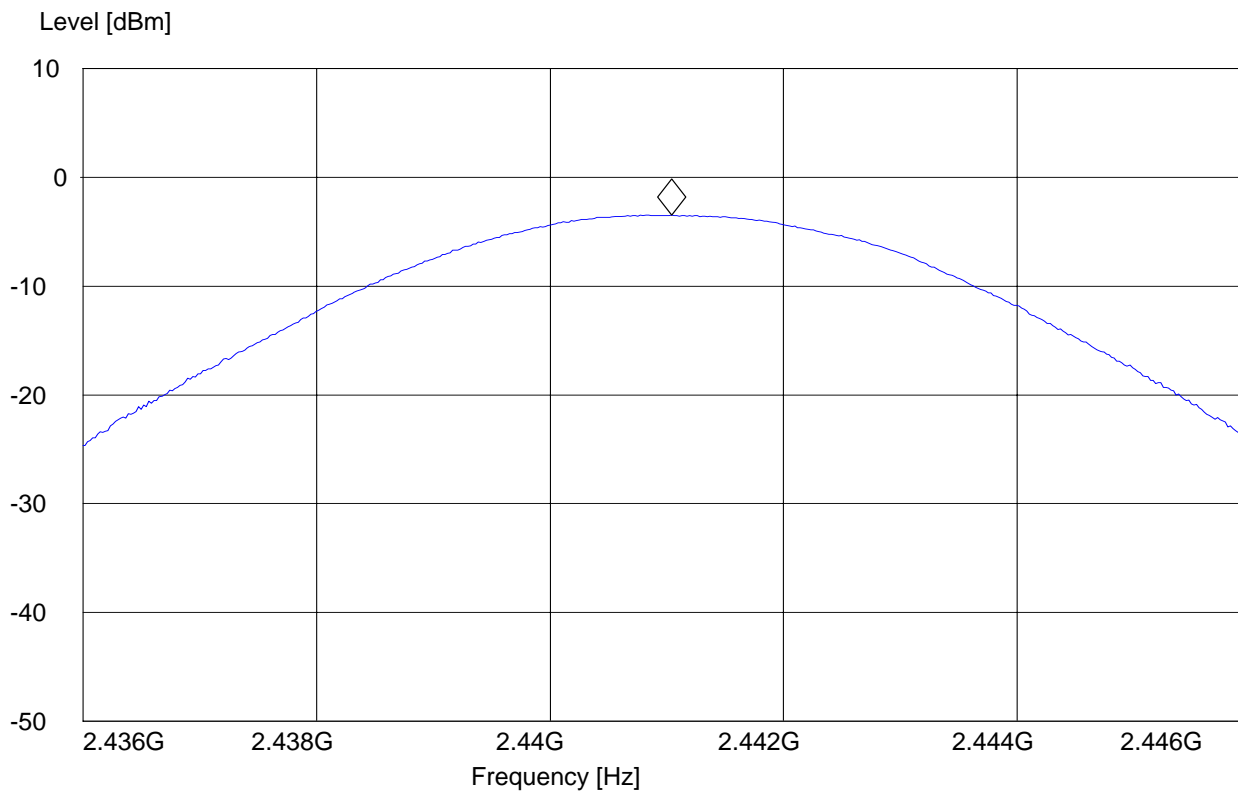
EIRP 2441MHz GFSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 39; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT mid channel"

Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Marker: 2.44104008 GHz -3.5 dBm





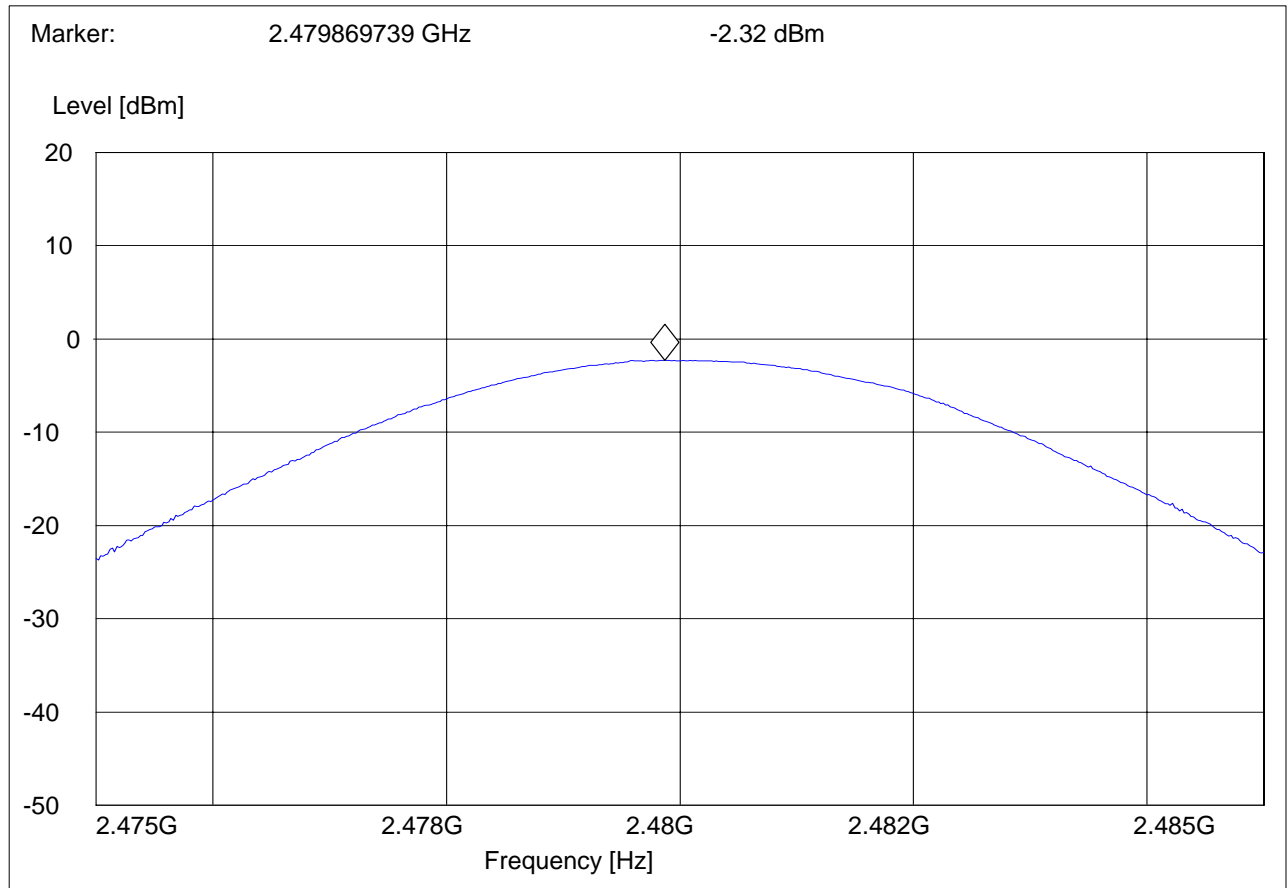
EIRP 2480MHz GFSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT high channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM

Short Description: EIRP Bluetooth channel-2480MHz
 MaxPeak





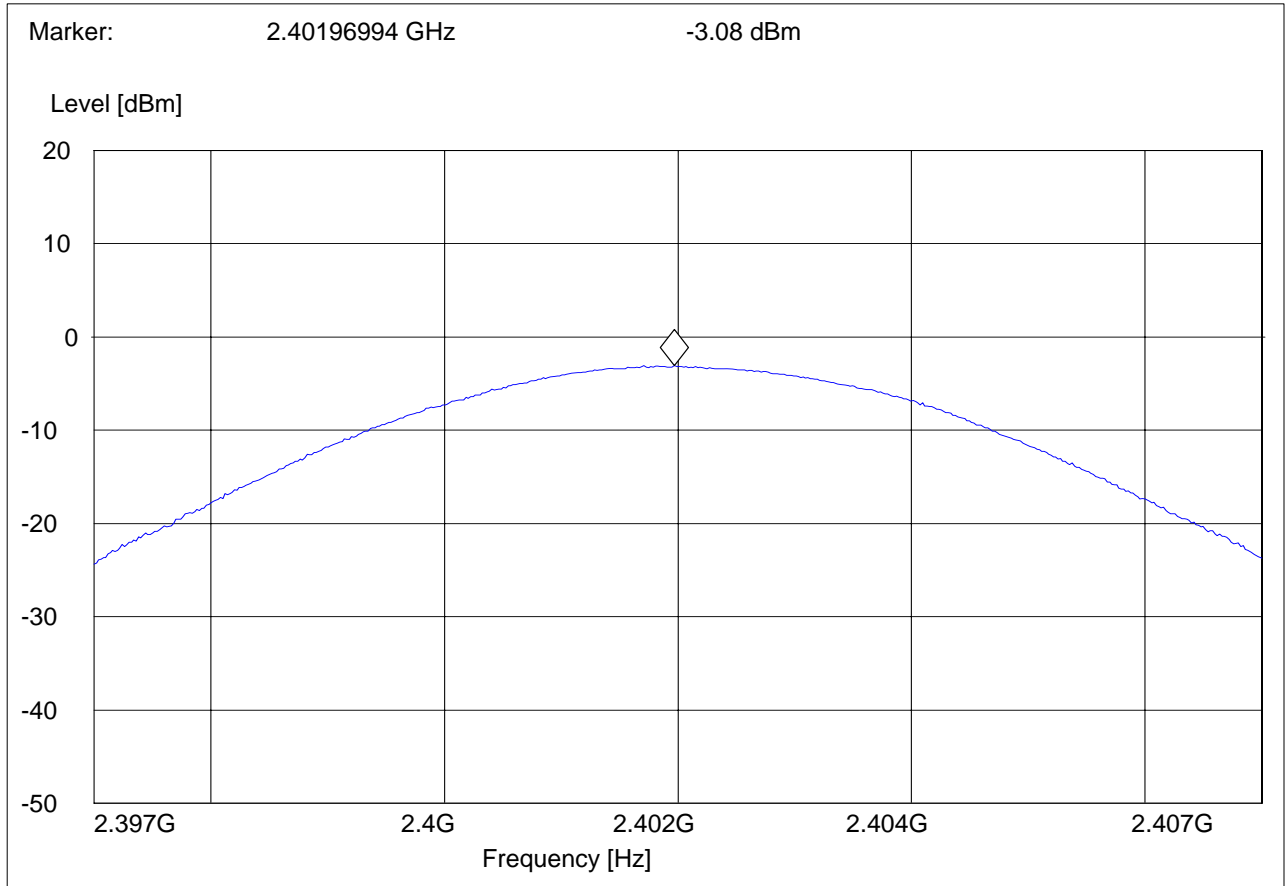
EIRP 2402MHz II / 4 DQPSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: 2-DH5; pi/4 DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT low channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM

Short Description: EIRP Bluetooth channel-2402MHz
 MaxPeak





EIRP 2441MHz II / 4 DQPSK

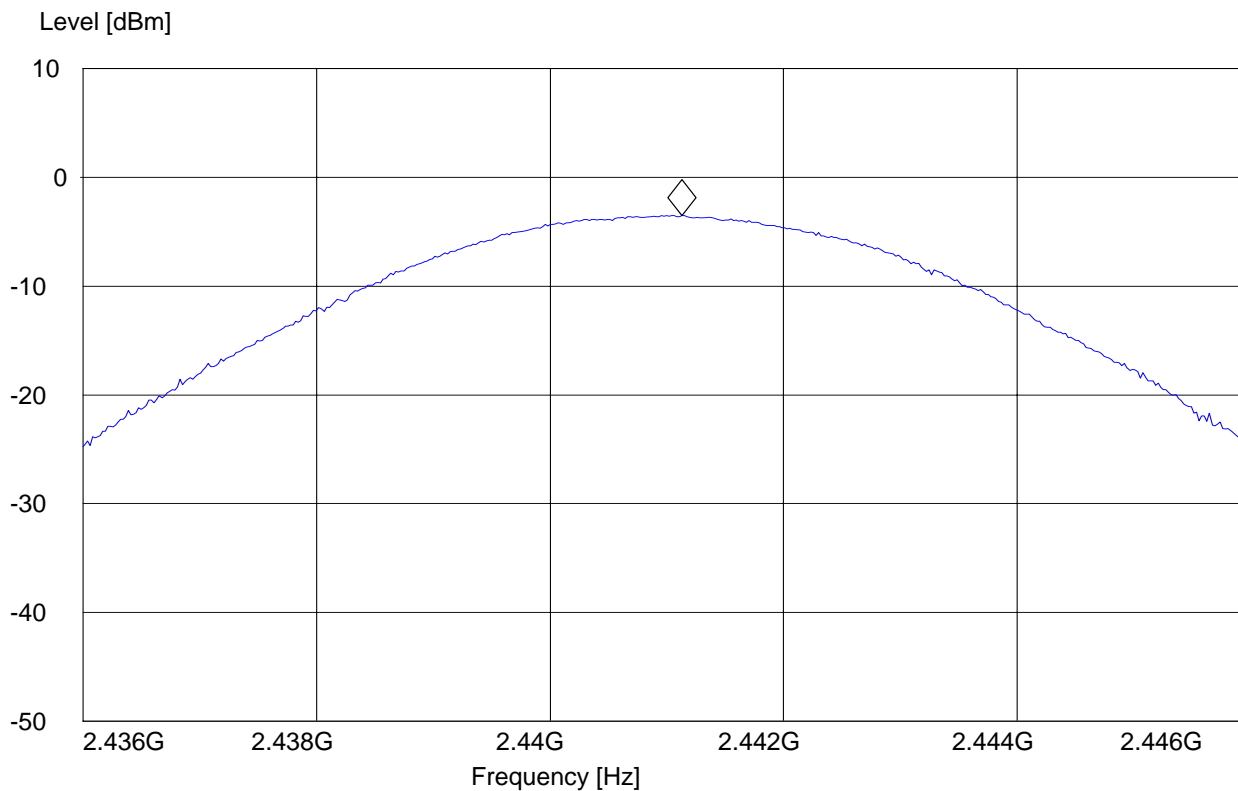
EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 39; Packet Type: 2-DH5; pi/4 DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT mid channel"

Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Short Description: EIRP Bluetooth channel-2441MHz

Marker: 2.441128257 GHz -3.55 dBm





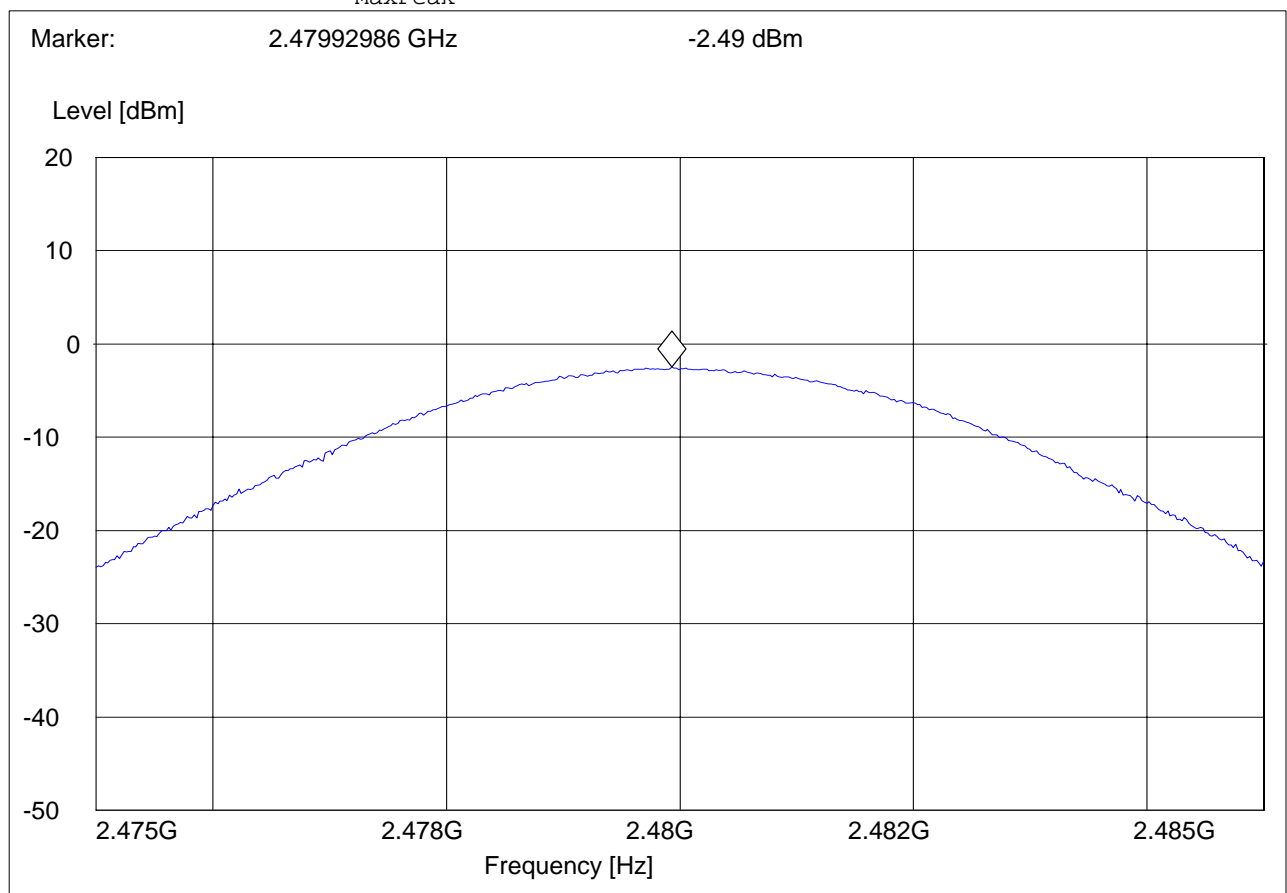
EIRP 2480MHz II / 4 DQPSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 2-DH5; pi/4 DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT high channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM

Short Description: EIRP Bluetooth channel-2480MHz
 MaxPeak



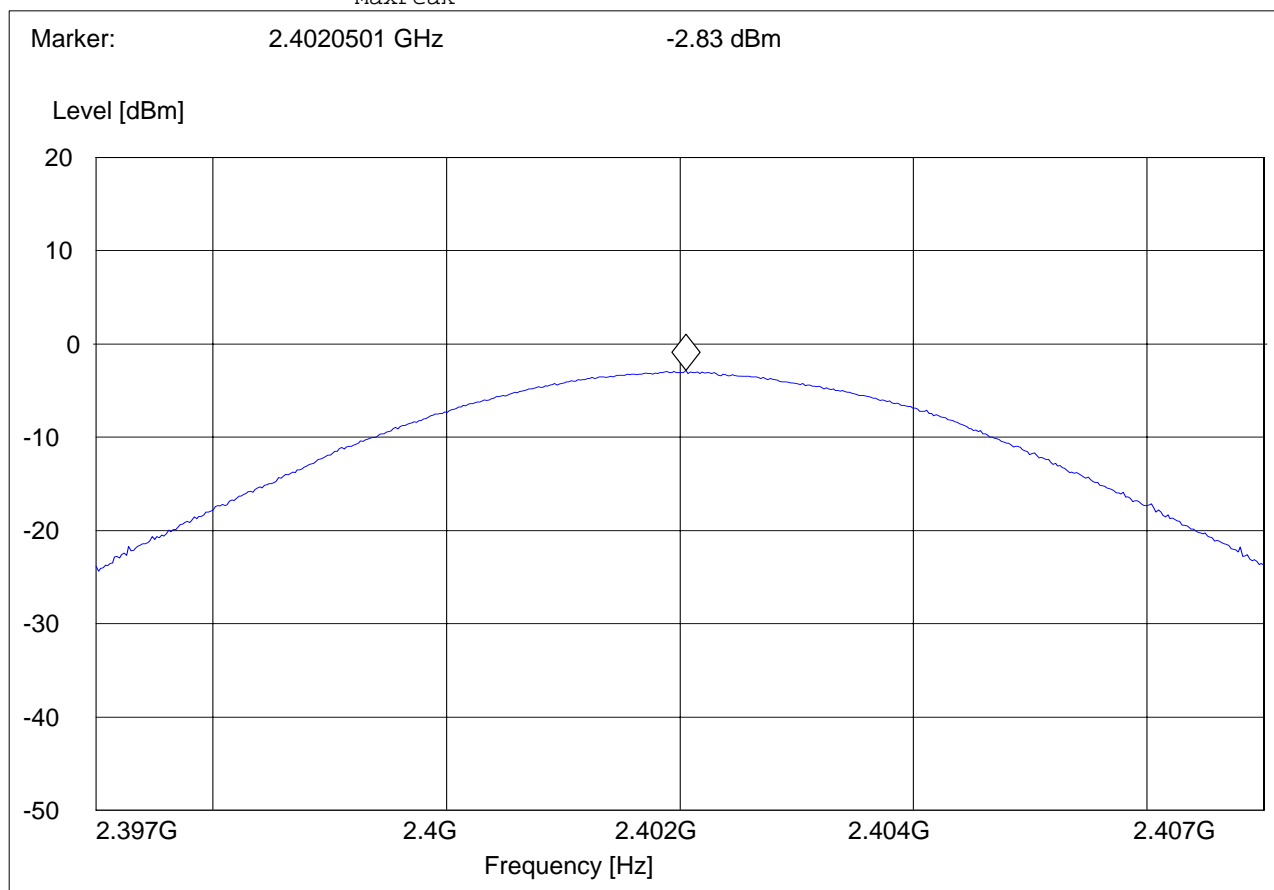


EIRP 2402MHz 8DPSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT low channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			





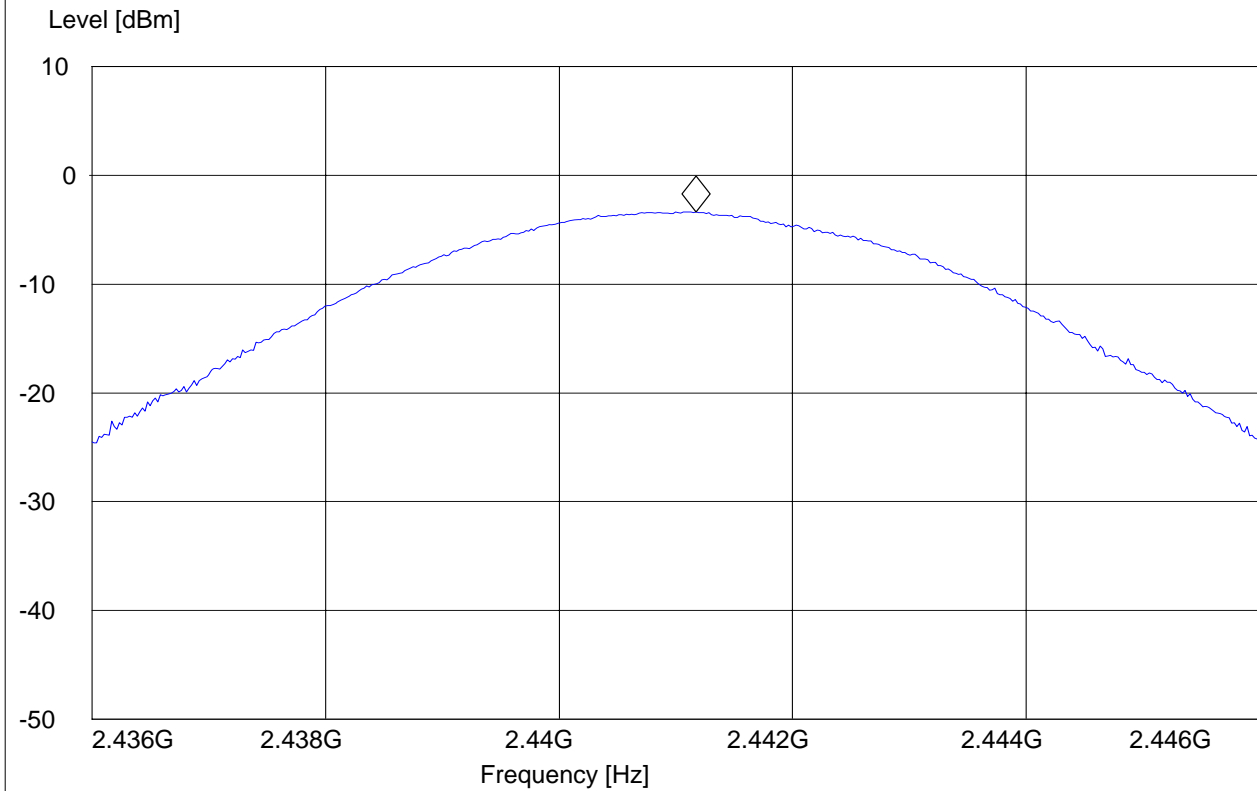
EIRP 2441MHz 8DPSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 39; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT mid channel"

Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
2.4 GHz	2.4 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Marker: 2.441172345 GHz -3.35 dBm





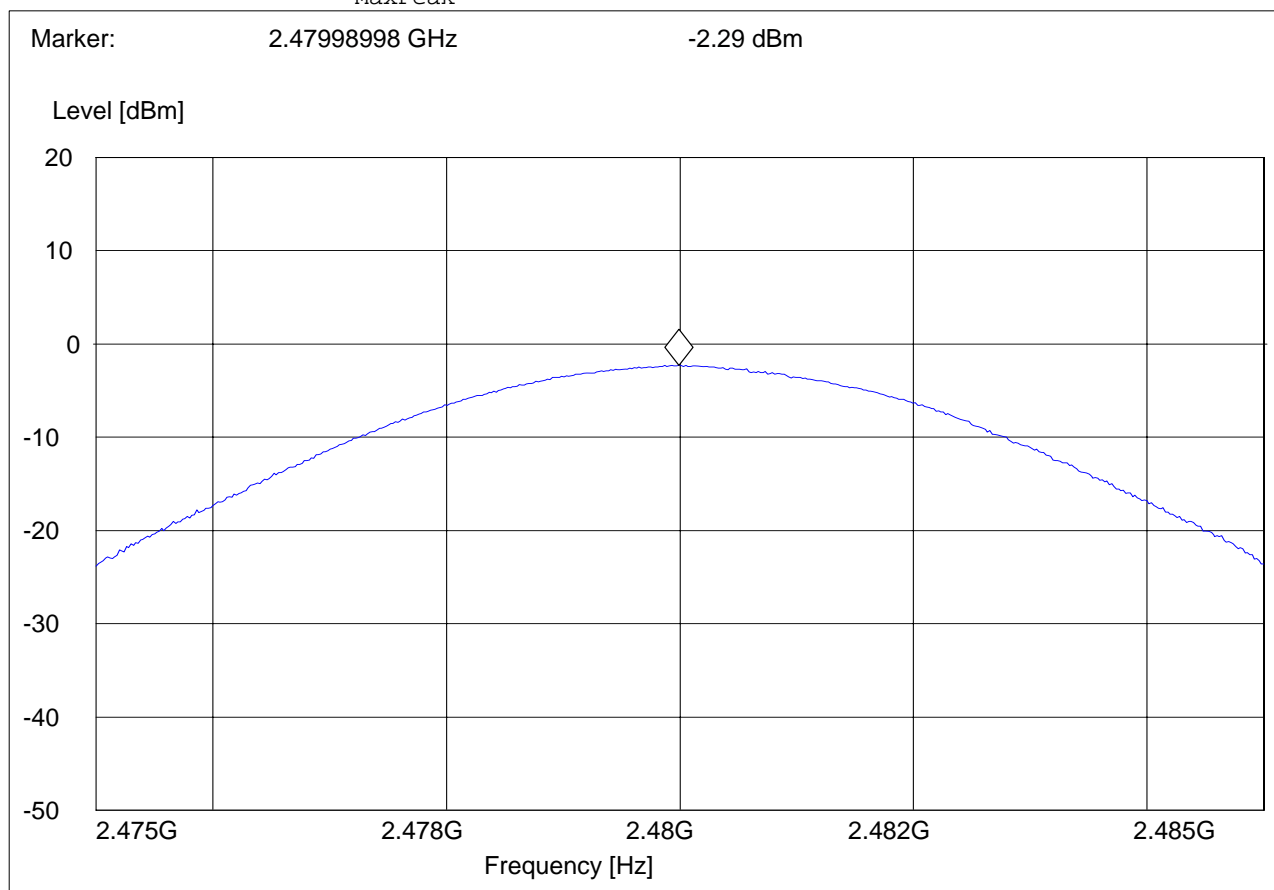
EIRP 2480MHz 8DPSK

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments:

SWEEP TABLE: "EIRP BT high channel"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM

Short Description: EIRP Bluetooth channel-2480MHz
 MaxPeak





5.2 RESTRICTED BAND EDGE COMPLIANCE RADIATED §15.247/15.205

5.2.1 LIMITS

30.□ Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

*PEAK LIMIT= 74dBuV/m

*AVG. LIMIT= 54dBuV/m

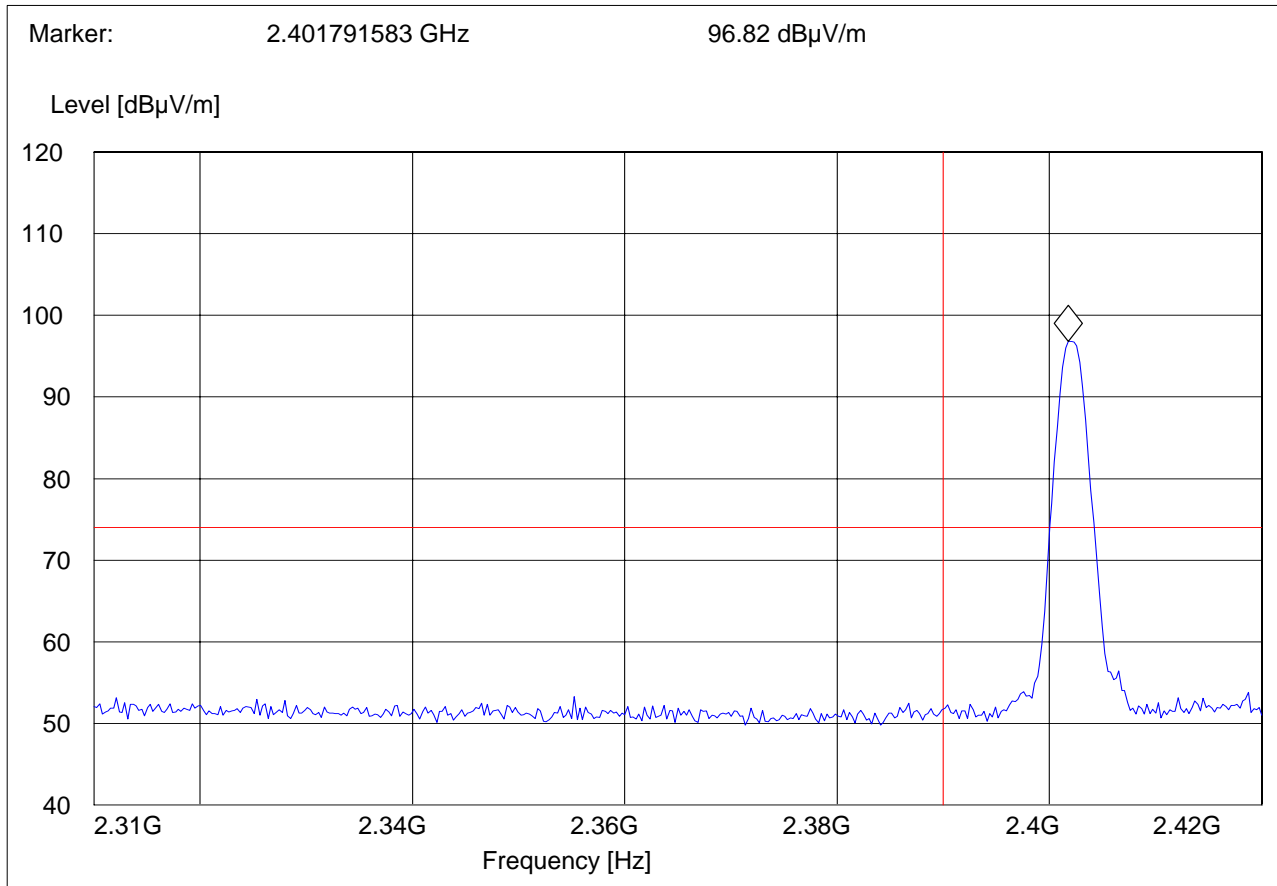


**5.2.2 RESULTS: GFSK
 (2402MHz) LOWER BAND EDGE PEAK –GFSK MODULATION**

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert
		MaxPeak			



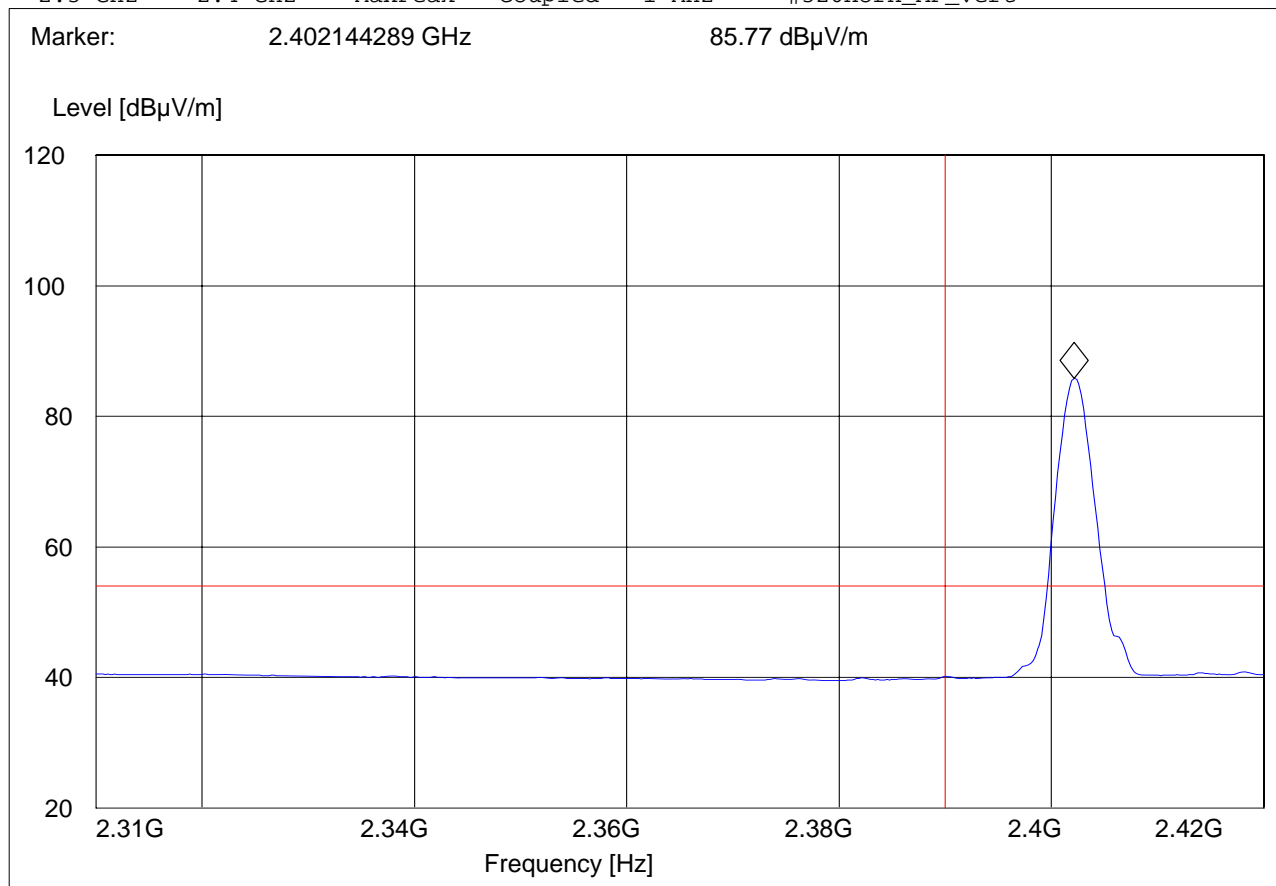


(2402MHz) LOWER BAND EDGE AVERAGE –GFSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC power supply
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert



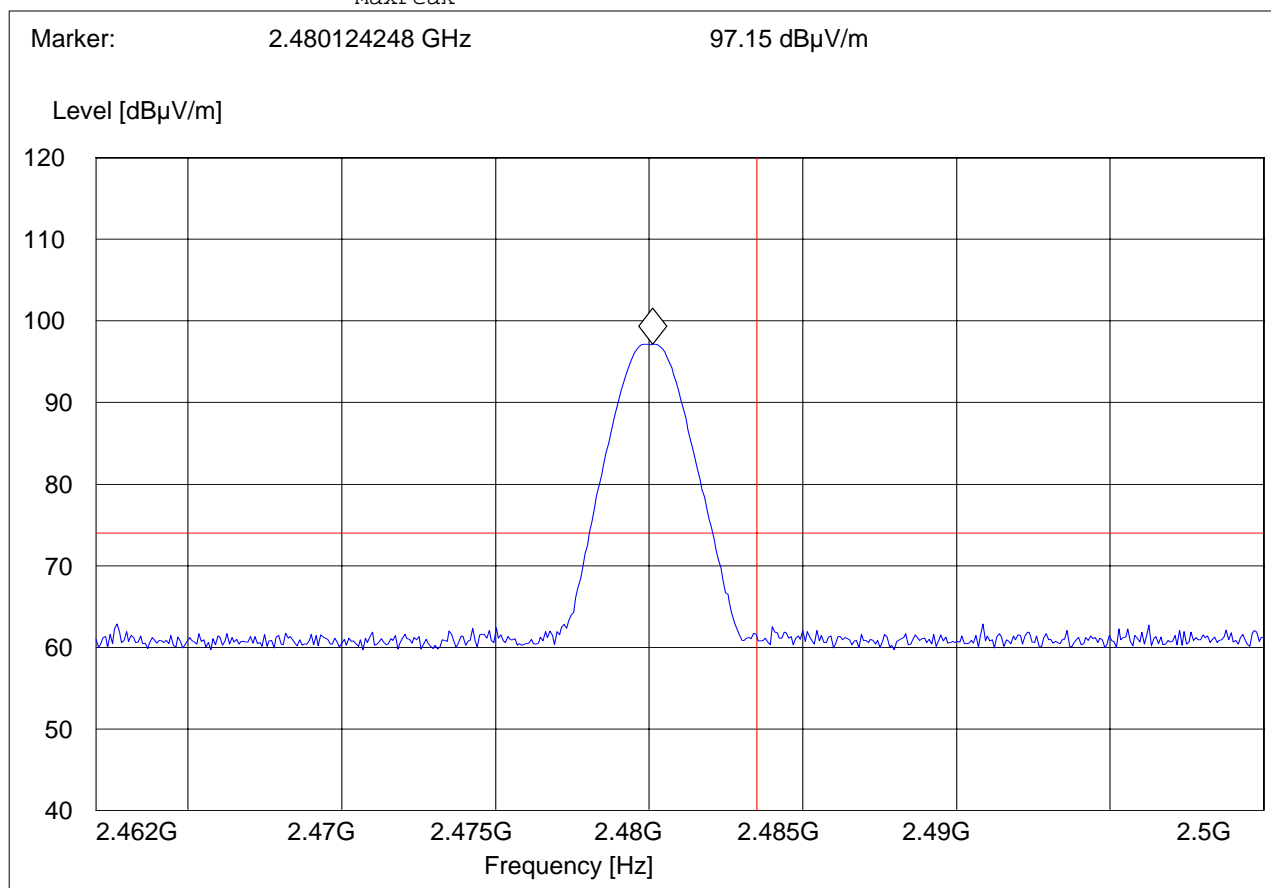


(2480MHz) HIGHER BAND EDGE PEAK –GFSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert
		MaxPeak			



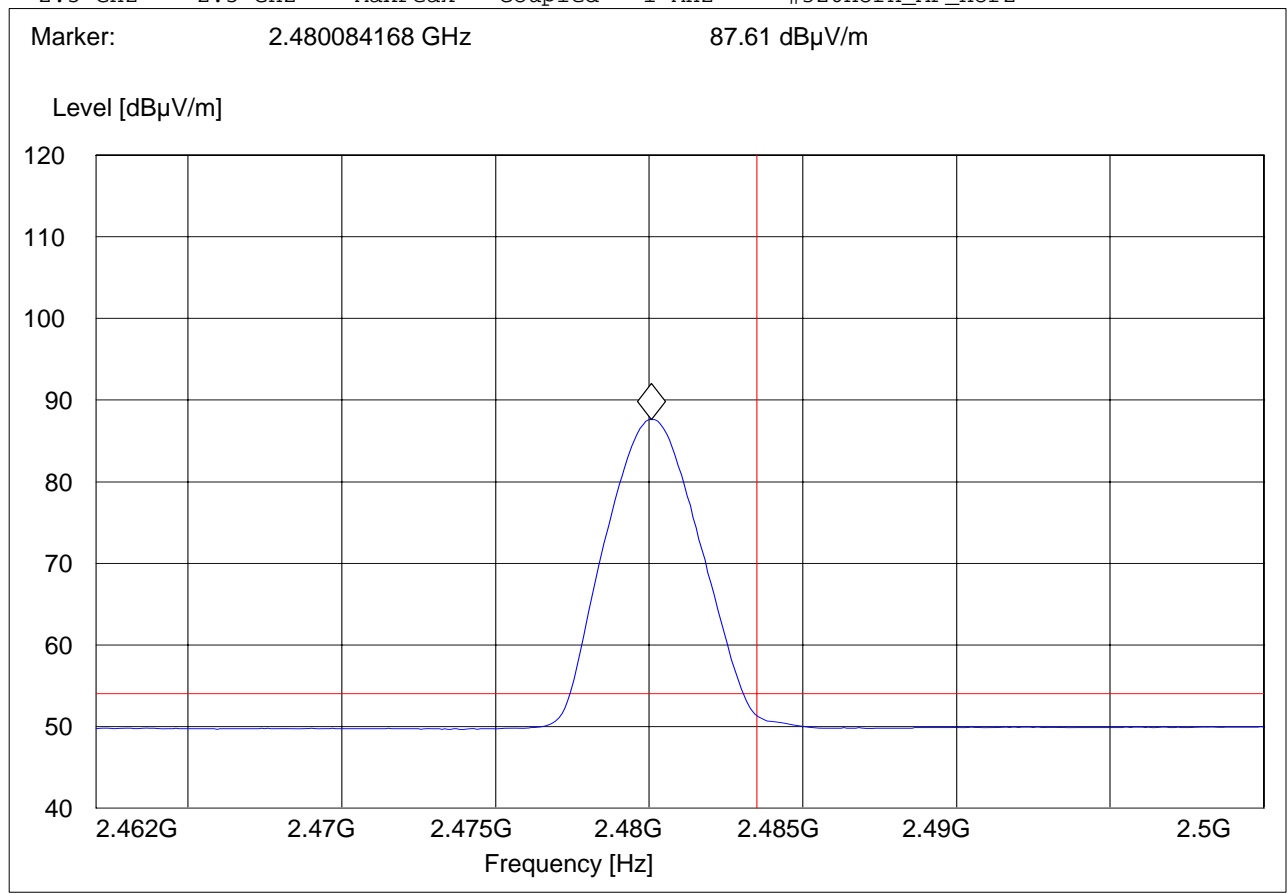


HIGHER BAND EDGE AVERAGE-GFSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_horz





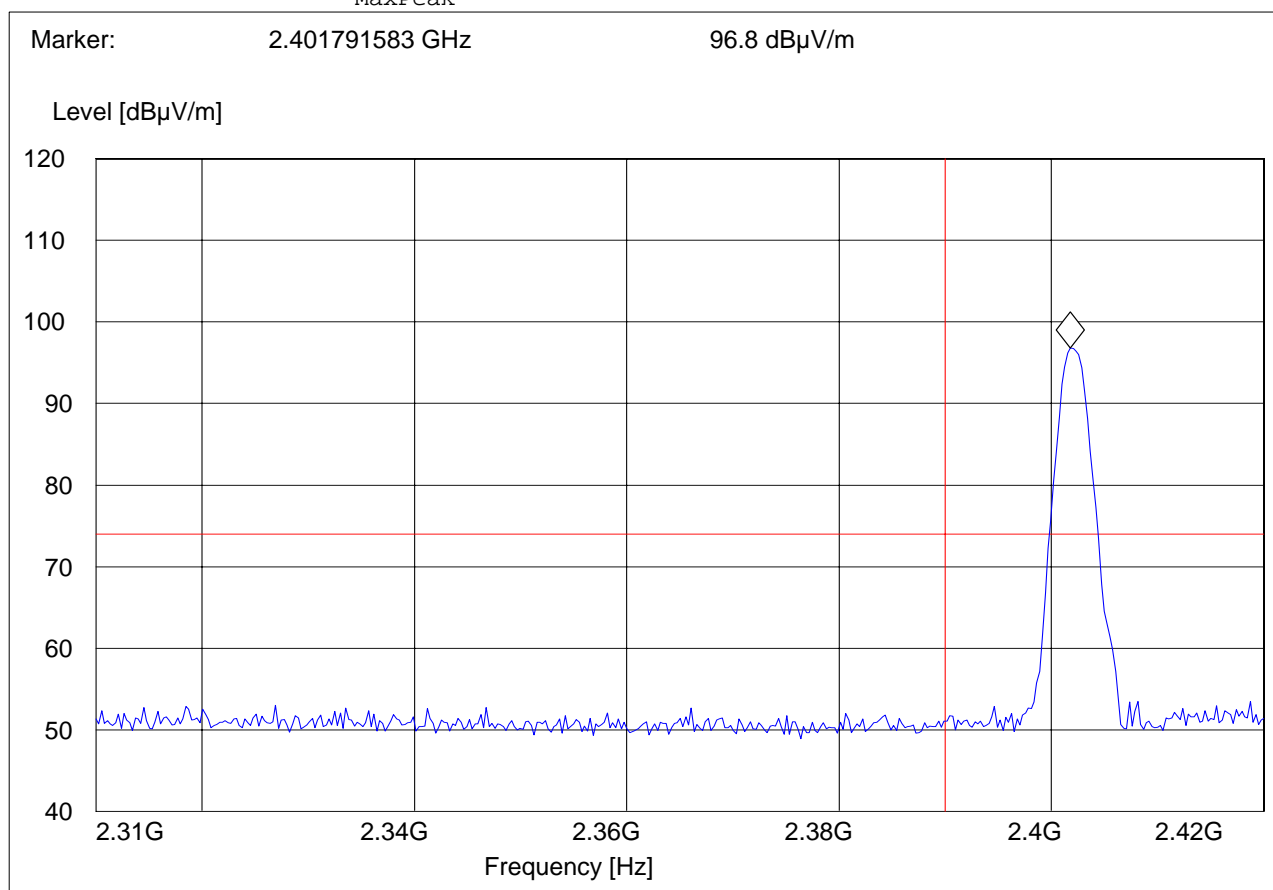
5.2.3 RESULTS: $\pi/4$ DQPSK

(2402MHz) LOWER BAND EDGE PEAK – $\pi/4$ DQPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: 2-DH5; $\pi/4$ DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert
		MaxPeak			



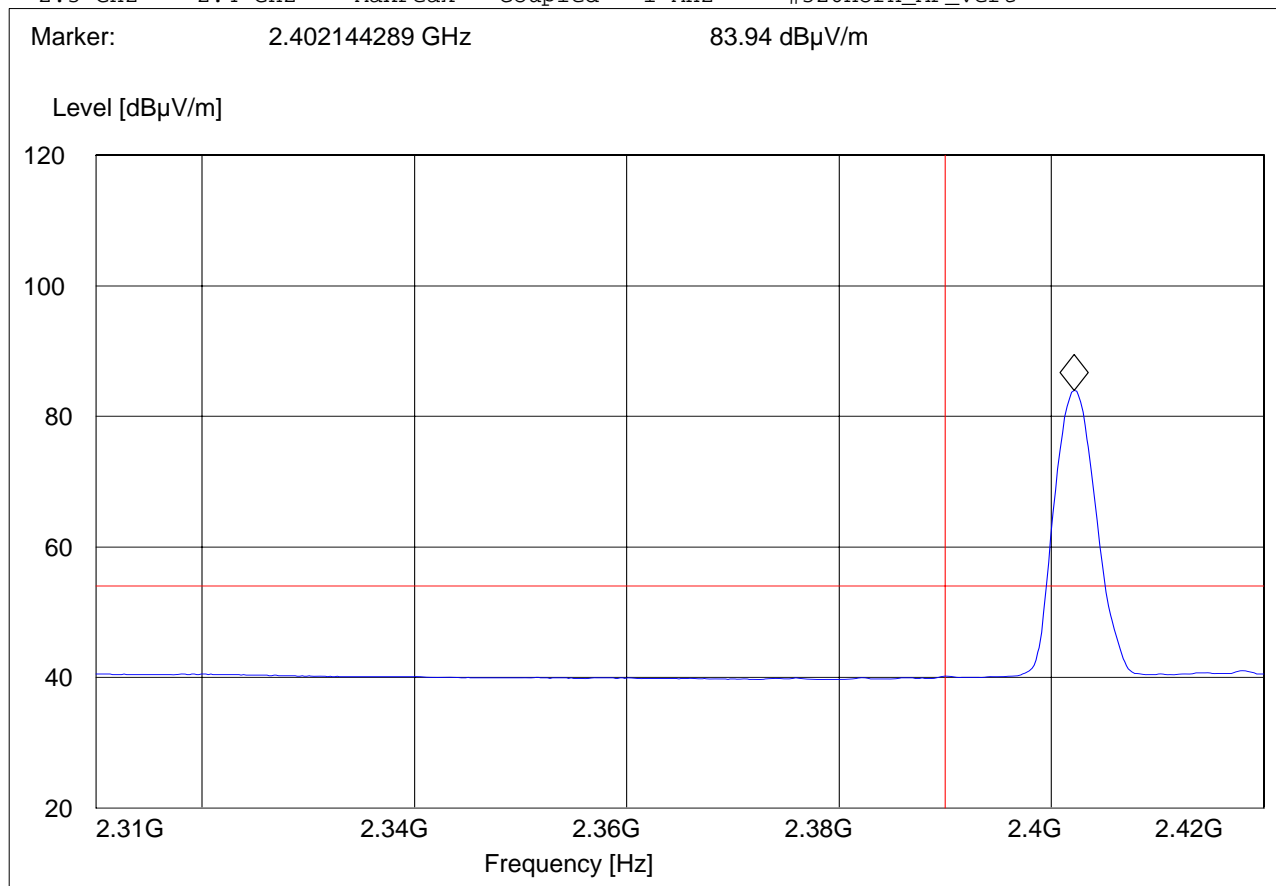


(2402MHz) LOWER BAND EDGE AVERAGE $-\pi/4$ DQPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: 2-DH5; pi/4 DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert



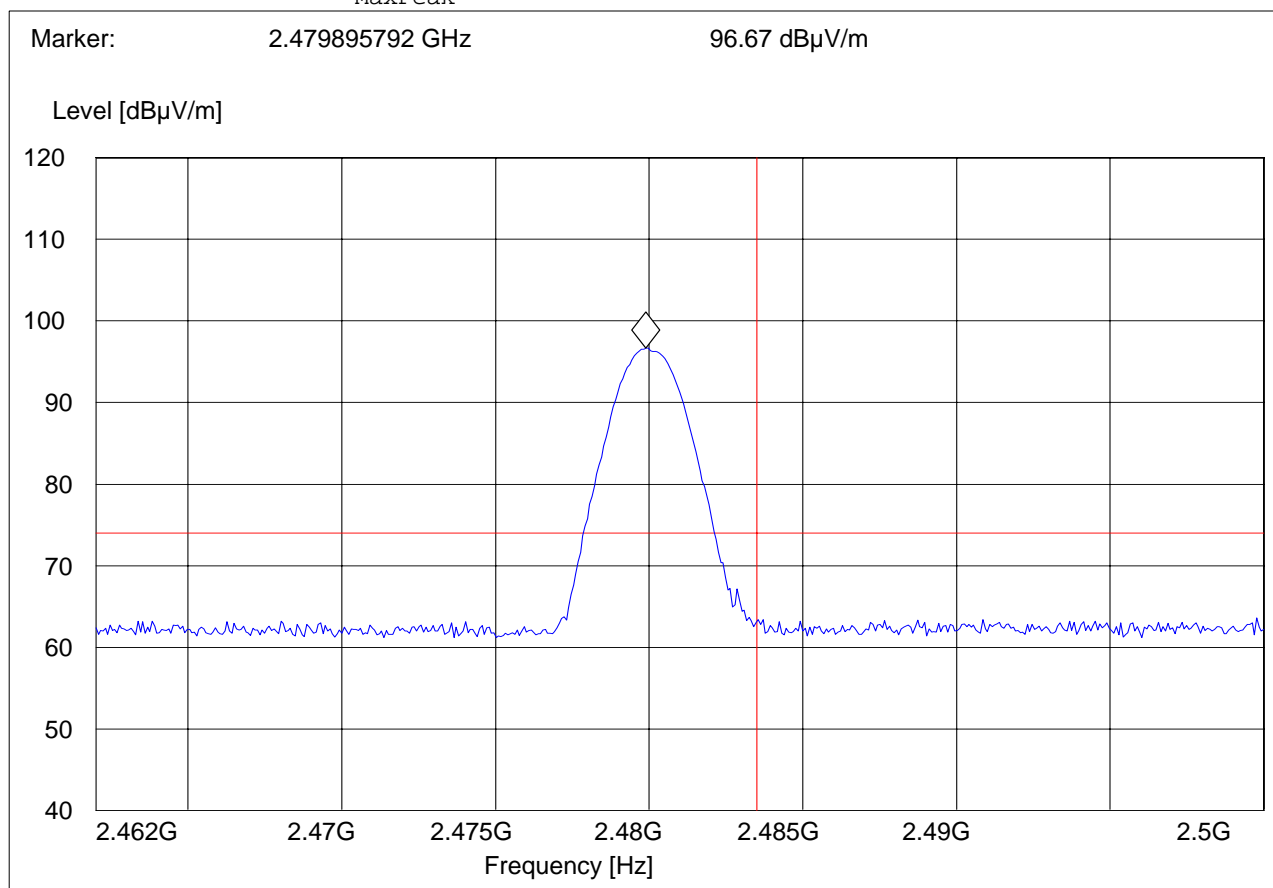


(2480MHz) HIGHER BAND EDGE PEAK $-\pi/4$ DQPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 2-DH5; pi/4 DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert
		MaxPeak			



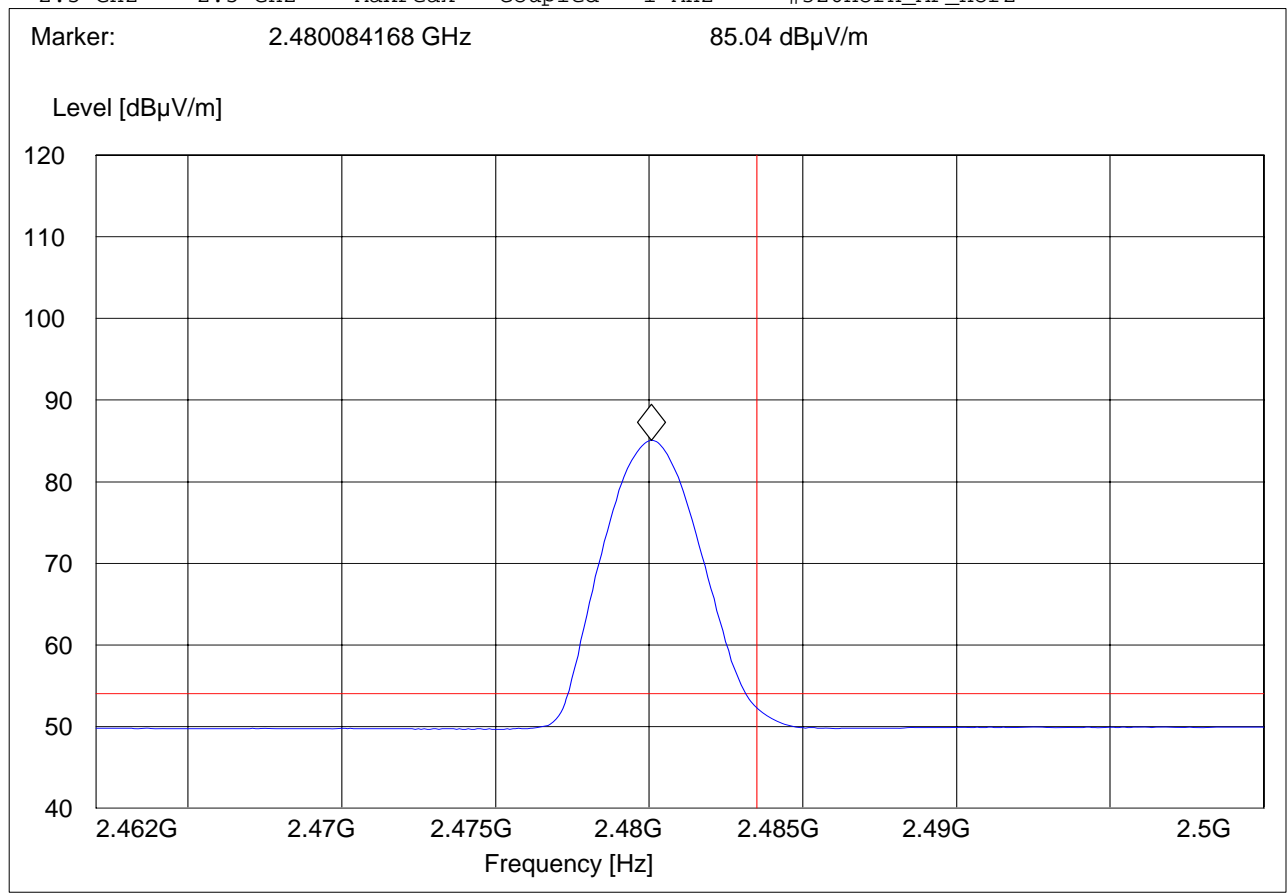


HIGHER BAND EDGE AVERAGE- $\pi/4$ DQPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 2-DH5; $\pi/4$ DQPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_horz





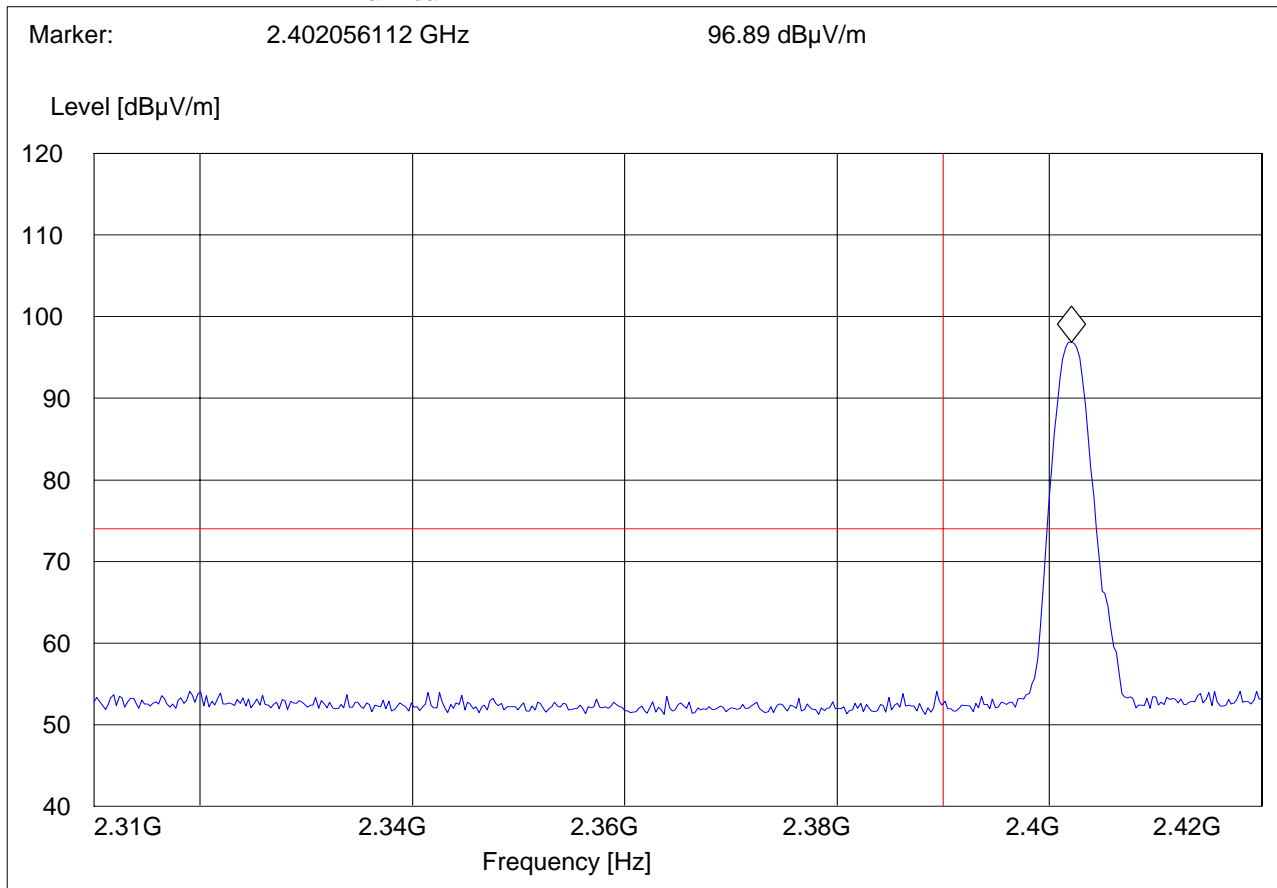
5.2.4 RESULTS: 8DPSK

(2402MHz) LOWER BAND EDGE PEAK – 8DPSK MODULATION

EUT: REU
Customer:: Harman Becker
Test Mode: BT CH 0; Packet Type: 3-DH5; 8DPSK
ANT Orientation: H
EUT Orientation: H
Test Engineer: Satya
Voltage:
Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert



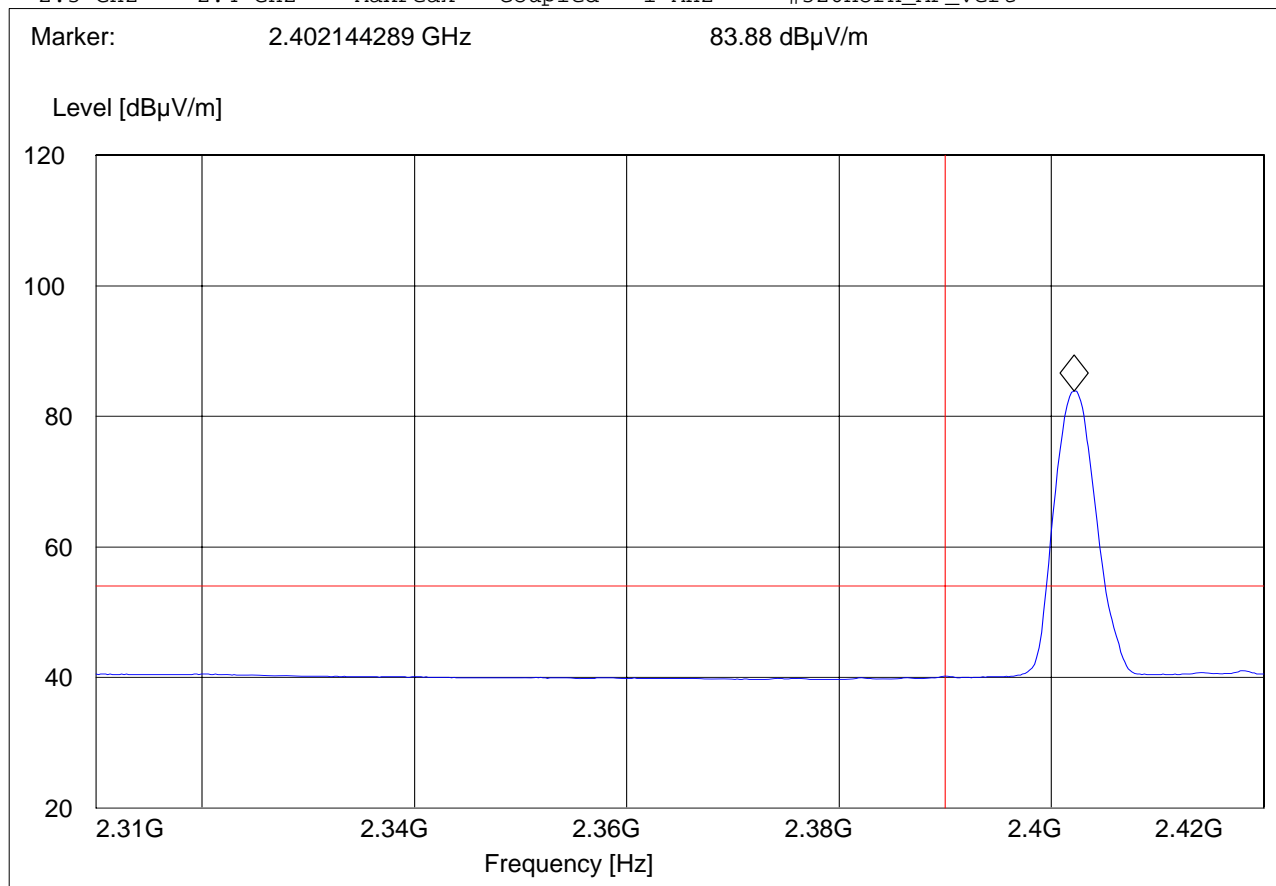


(2402MHz) LOWER BAND EDGE AVERAGE -8DPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 LBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.3 GHz	2.4 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert





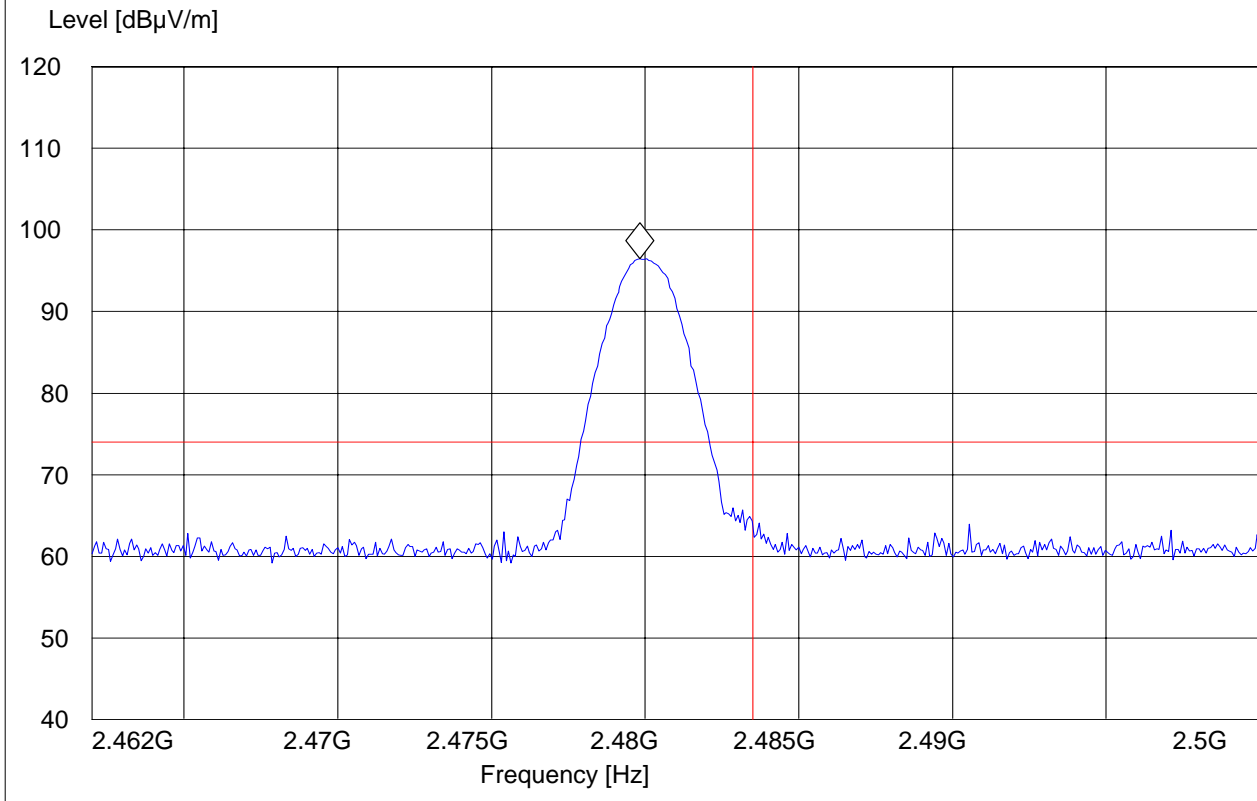
(2480MHz) HIGHER BAND EDGE PEAK – 8DPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_PK"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert
		MaxPeak			

Marker: 2.479819639 GHz 96.49 dBµV/m



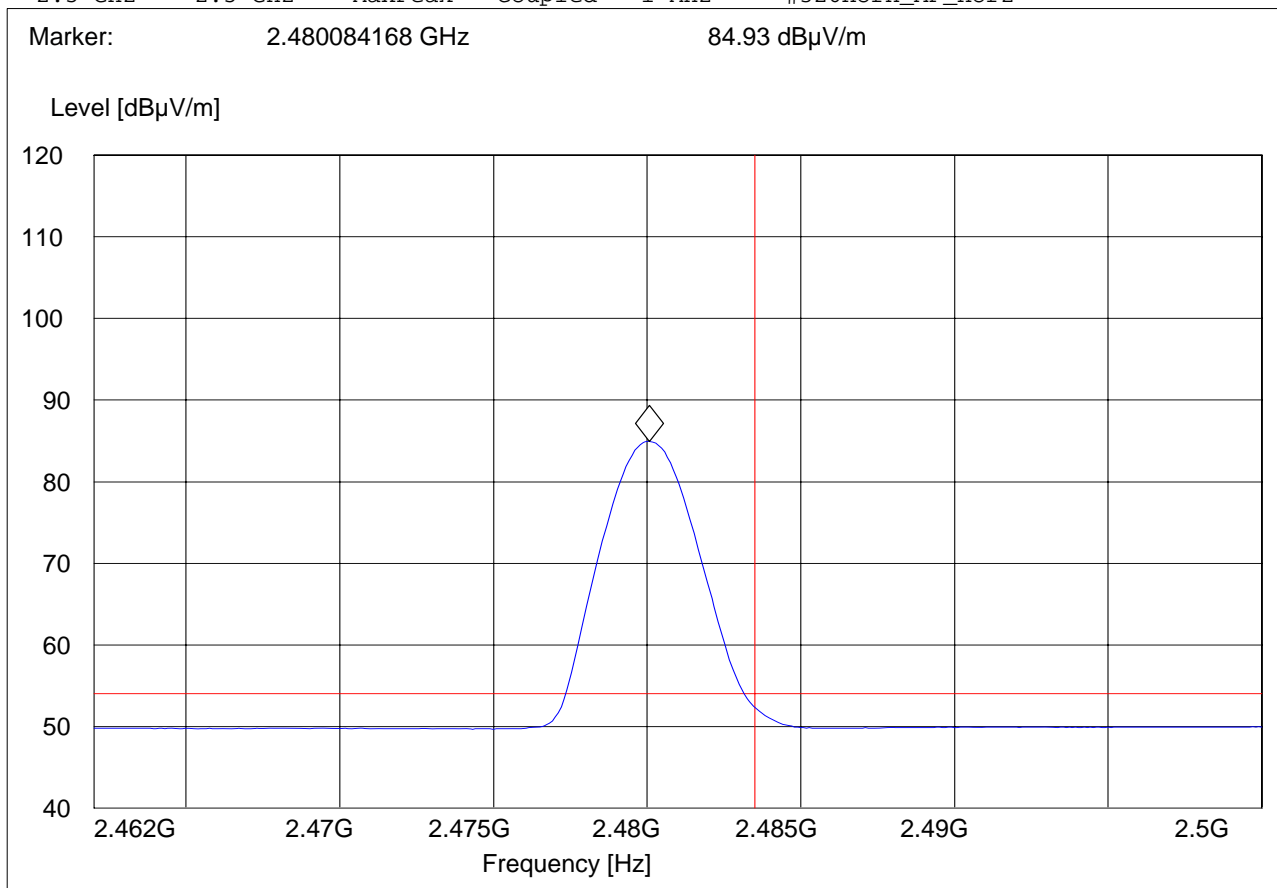


HIGHER BAND EDGE AVERAGE-8DPSK MODULATION

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: 3-DH5; 8DPSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage:
 Comments: Marker placed on transmit signal

SWEEP TABLE: "FCC15.247 HBE_AVG"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
2.5 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_horz





5.3 TRANSMITTER SPURIOUS EMISSIONS RADIATED § 15.247/15.205/15.209

5.3.1 LIMITS

Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

*PEAK LIMIT= 74dBuV/m

*AVG. LIMIT= 54dBuV/m

NOTE:

1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. All measurements are done in peak mode using an average limit , unless specified with the plots.

Results for the radiated measurements below 30MHz according § 15.33

Frequency	Measured values	Remarks
9KHz – 30MHz	No emissions found, caused by the EUT	This is valid for all the tested channels

All Spurious Emission measurements are done in GFSK mode and represents the worse case emission from the device.



5.3.2 RESULTS

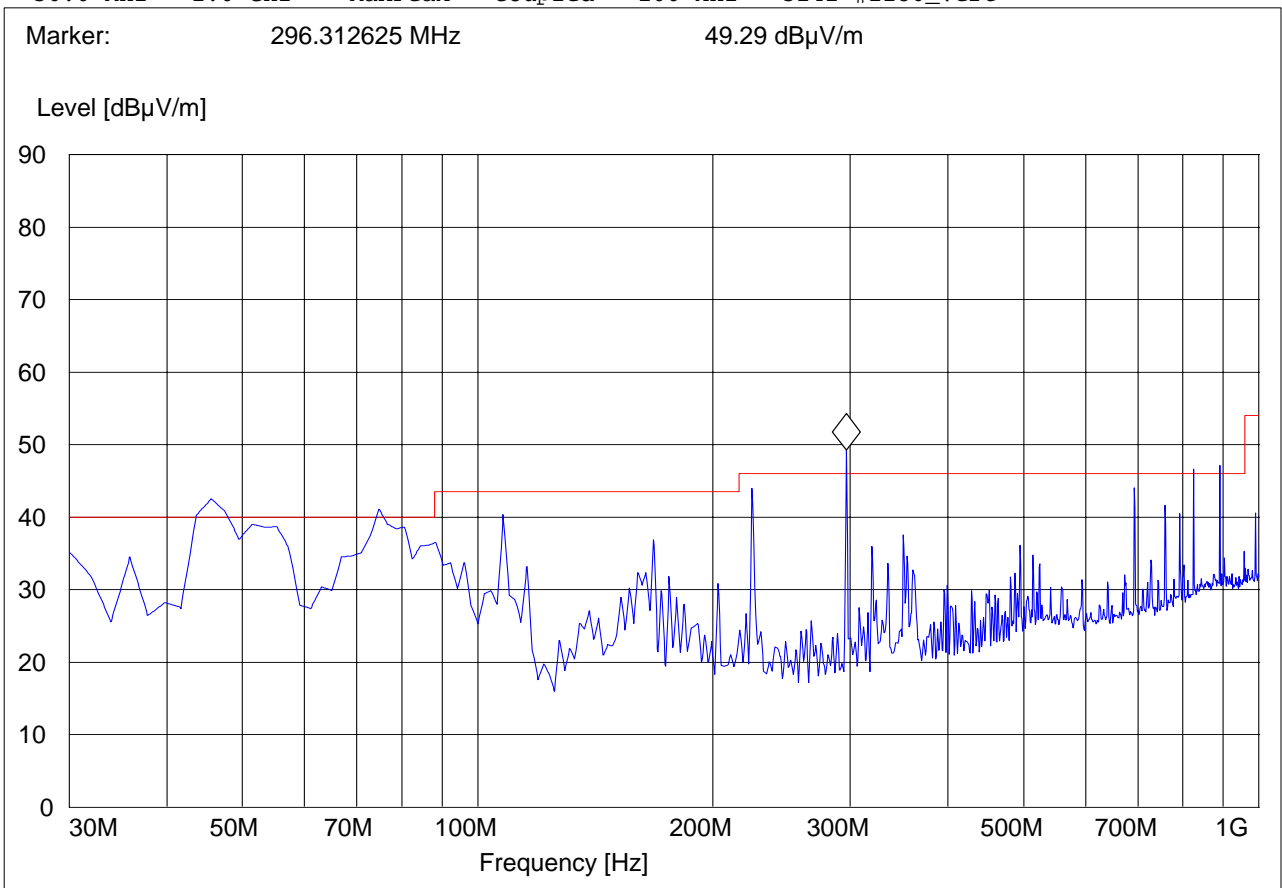
30MHz – 1GHz Antenna: vertical.

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_30M-1G_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert

Marker: 296.312625 MHz 49.29 dBµV/m



The spurious emission over the limits is demonstrated not from the Bluetooth transceiver itself. The car stereo itself is an exempted device per FCC rule 15.103(a). See the plot following that this emission remained the same with the Bluetooth transceiver turned off.



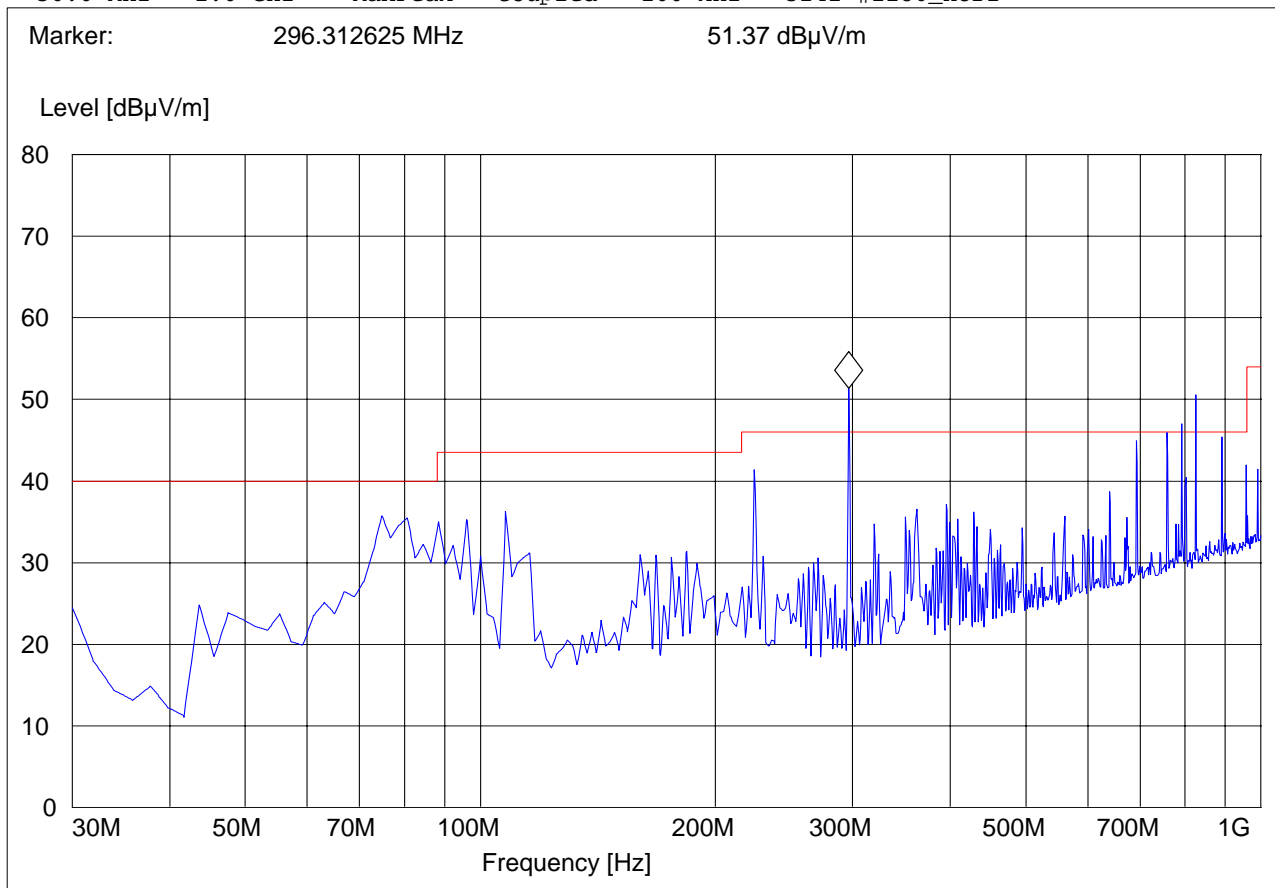
30MHz – 1GHz Antenna: horizontal

Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: h
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_30M-1G_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz



The spurious emission over the limits is demonstrated not from the Bluetooth transceiver itself. The car stereo itself is an exempted device per FCC rule 15.103(a). See the plot following that this emission remained the same with the Bluetooth transceiver turned off.



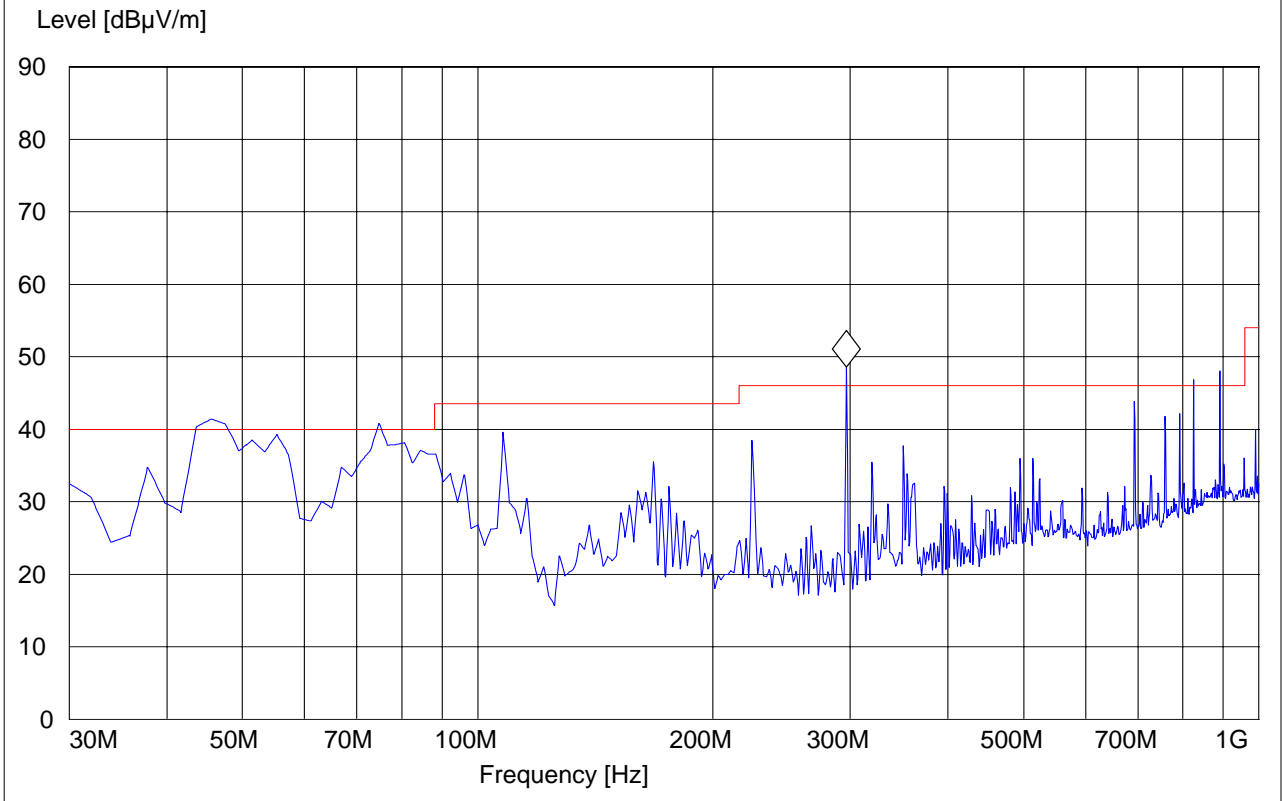
30MHz – 1GHz Antenna: vertical. Bluetooth Radio Disabled

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments: BT RADIO DISABLED

SWEEP TABLE: "FCC15.247_30M-1G_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert

Marker: 296.312625 MHz 48.61 dBµV/m





30MHz – 1GHz Antenna: horizontal. **Bluetooth Radio Disabled**

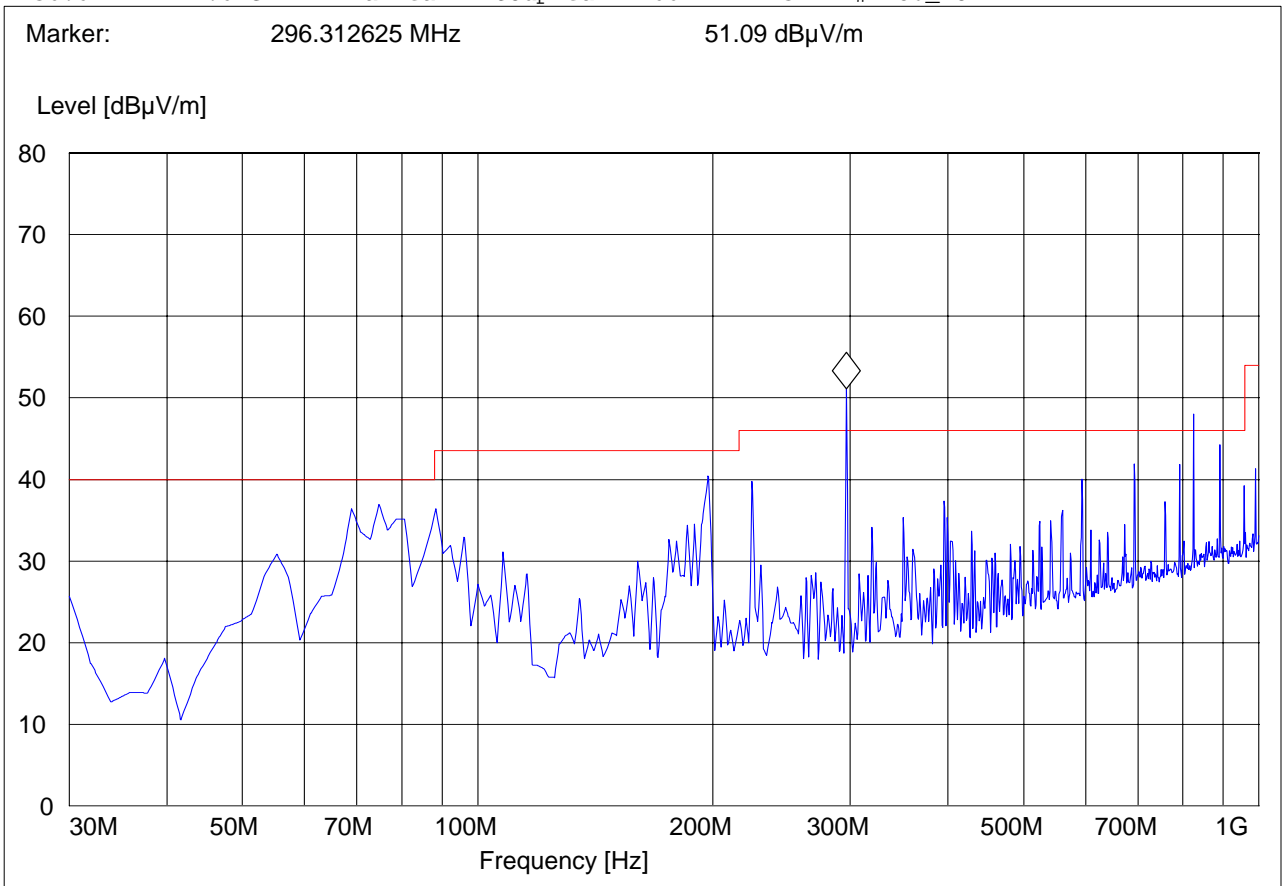
Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments: BT RADIO DISABLED

SWEEP TABLE: "FCC15.247_30M-1G_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz

Marker: 296.312625 MHz 51.09 dBµV/m





1-18GHz (2402MHz)

Note: The peak above the limit line is the carrier freq.

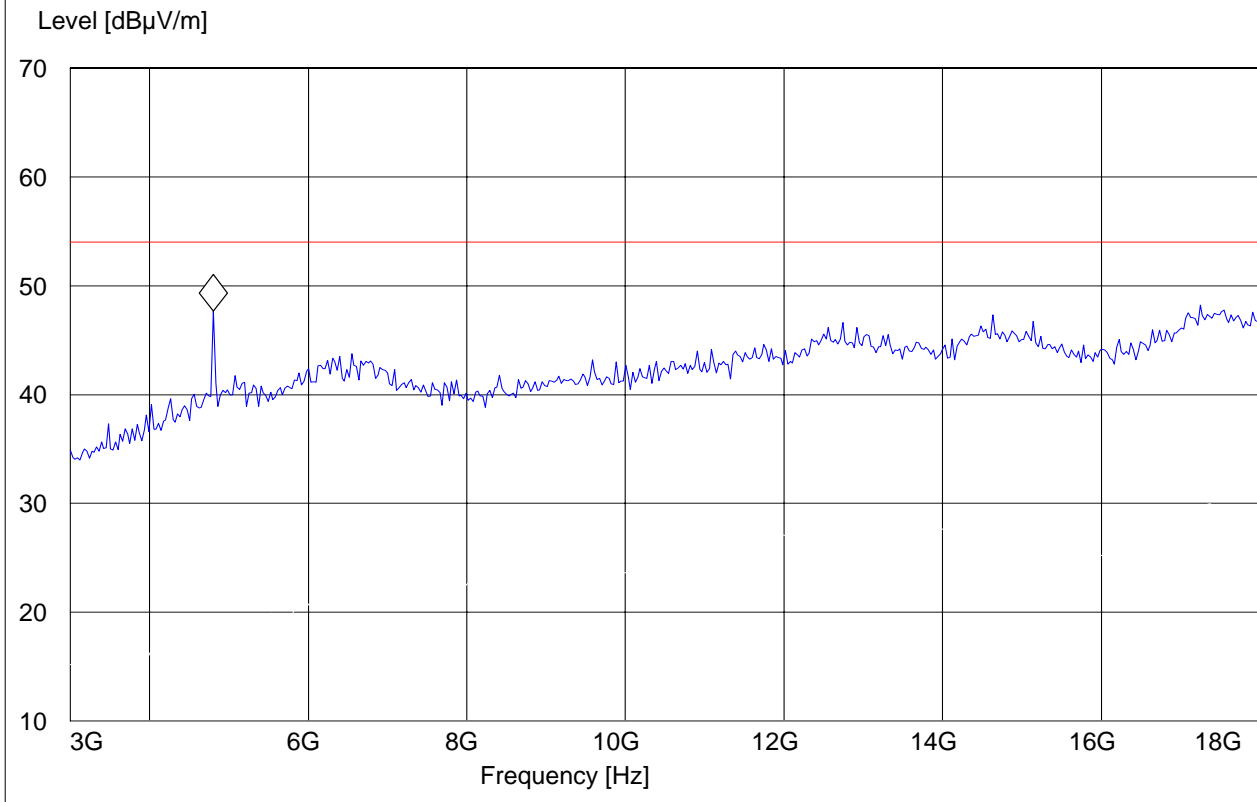
Note: Peak Reading vs. Average limit

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 0; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC power supply
 Comments: 2.4GHz notch filter used

SWEEP TABLE: "FCC15.247_3-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert

Marker: 4.803607214 GHz 47.69 dBµV/m



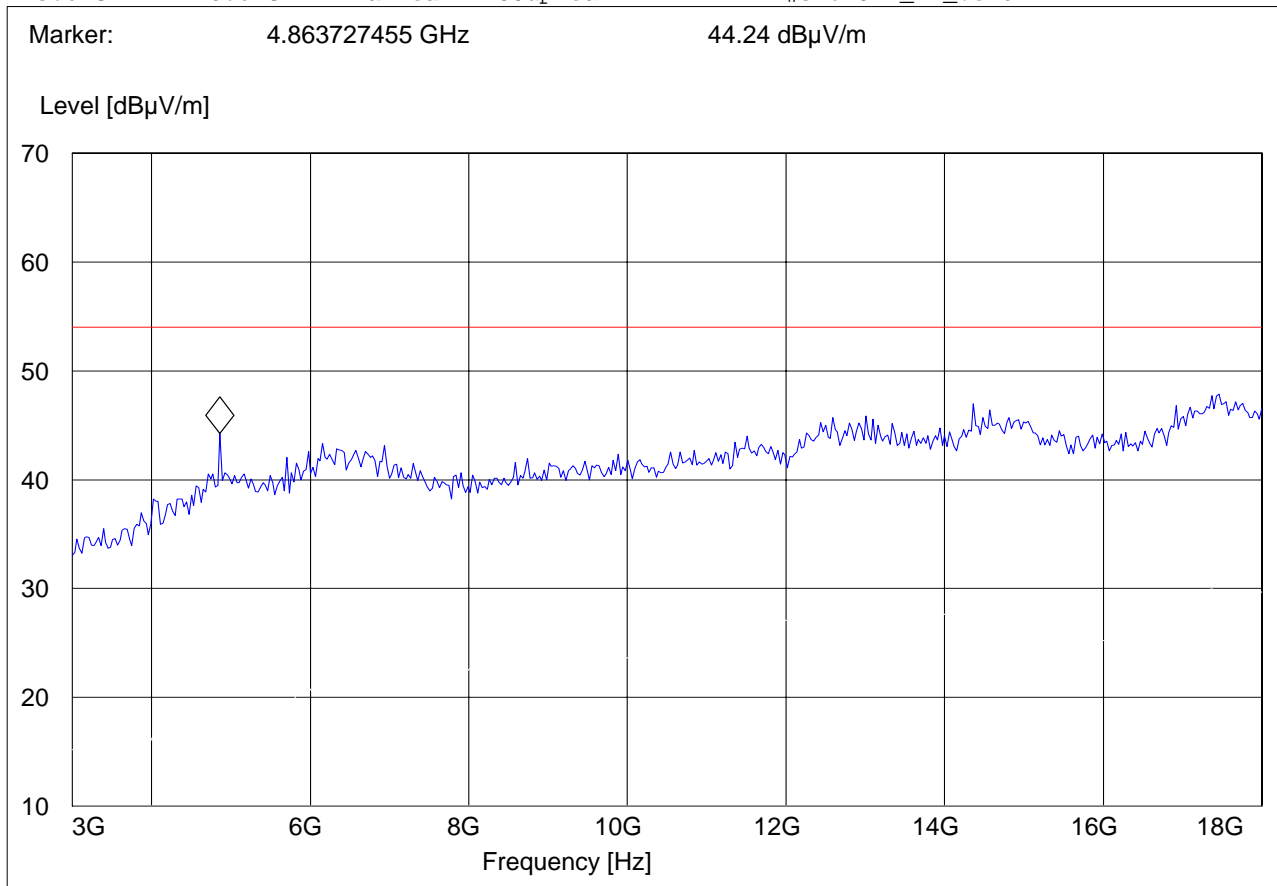


1-18GHz (2441MHz)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 39; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC power supply
 Comments: 2.4GHz notch filter used

SWEEP TABLE: "FCC15.247_3-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert





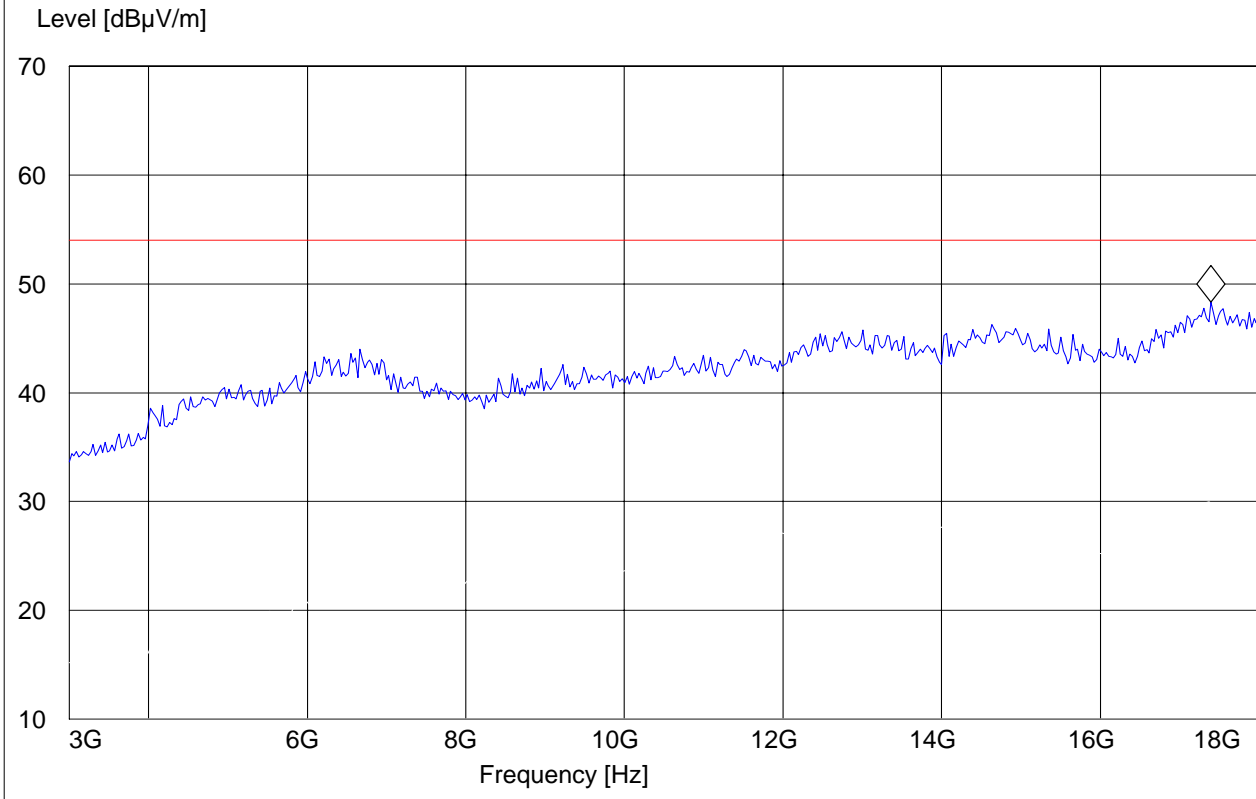
1-18GHz (2480MHz)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT CH 78; Packet Type: DH5; GFSK
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC power supply
 Comments: 2.4GHz notch filter used

SWEEP TABLE: "FCC15.247_3-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert

Marker: 17.398797595 GHz 48.31 dBµV/m





18-25GHz

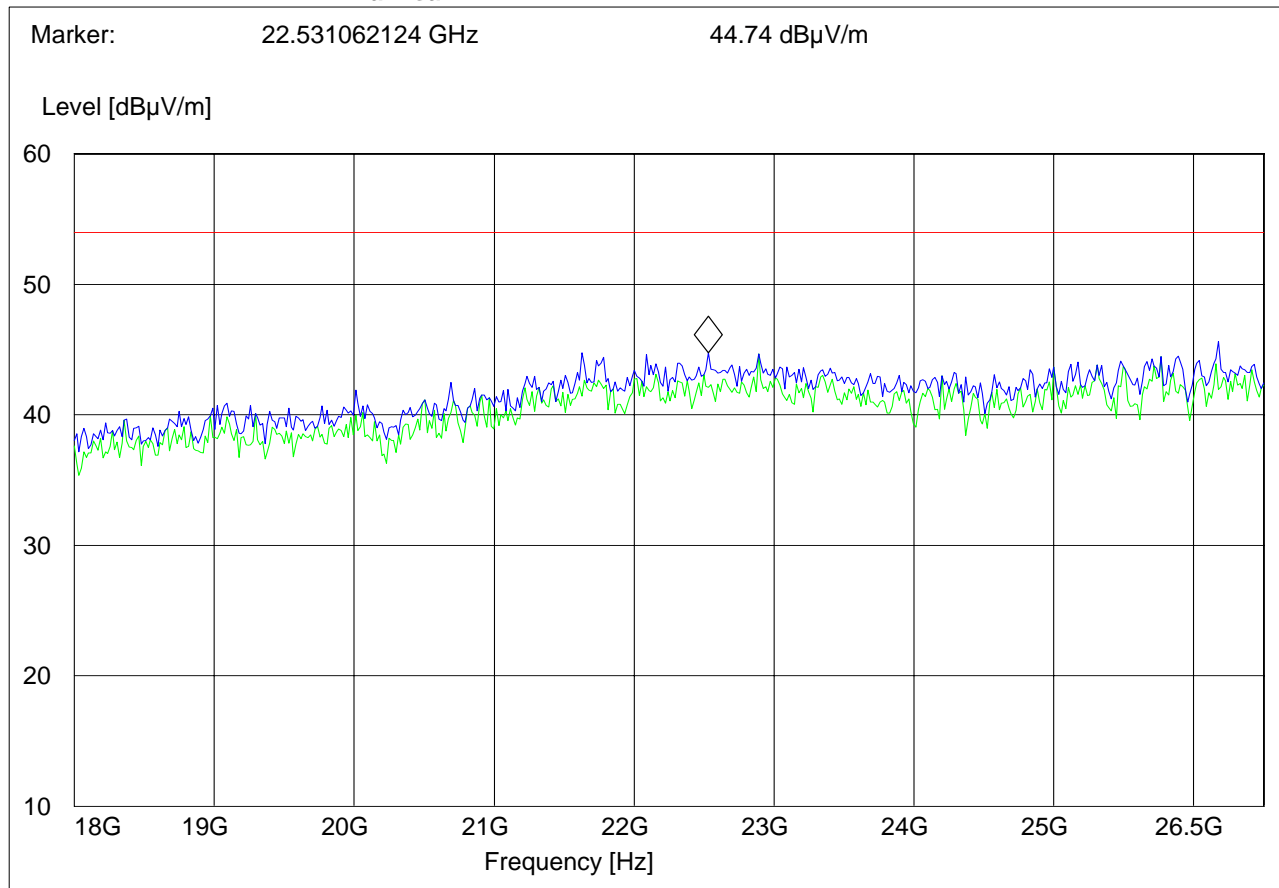
Note: This plot is valid for low, mid, high channels (worst-case plot) Note: Peak Reading vs.

Average limit

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_18-26.5G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
18.0 GHz	26.5 GHz	MaxPeak	Coupled	100 kHz	Horn # 3116_18-40G
		MaxPeak			





5.4 RECEIVER SPURIOUS RADIATION RSS-Gen(4.10)

5.4.1 LIMITS

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

NOTE:

1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. All measurements are done in peak mode using an average limit, unless specified with the plots.



5.4.2 Results

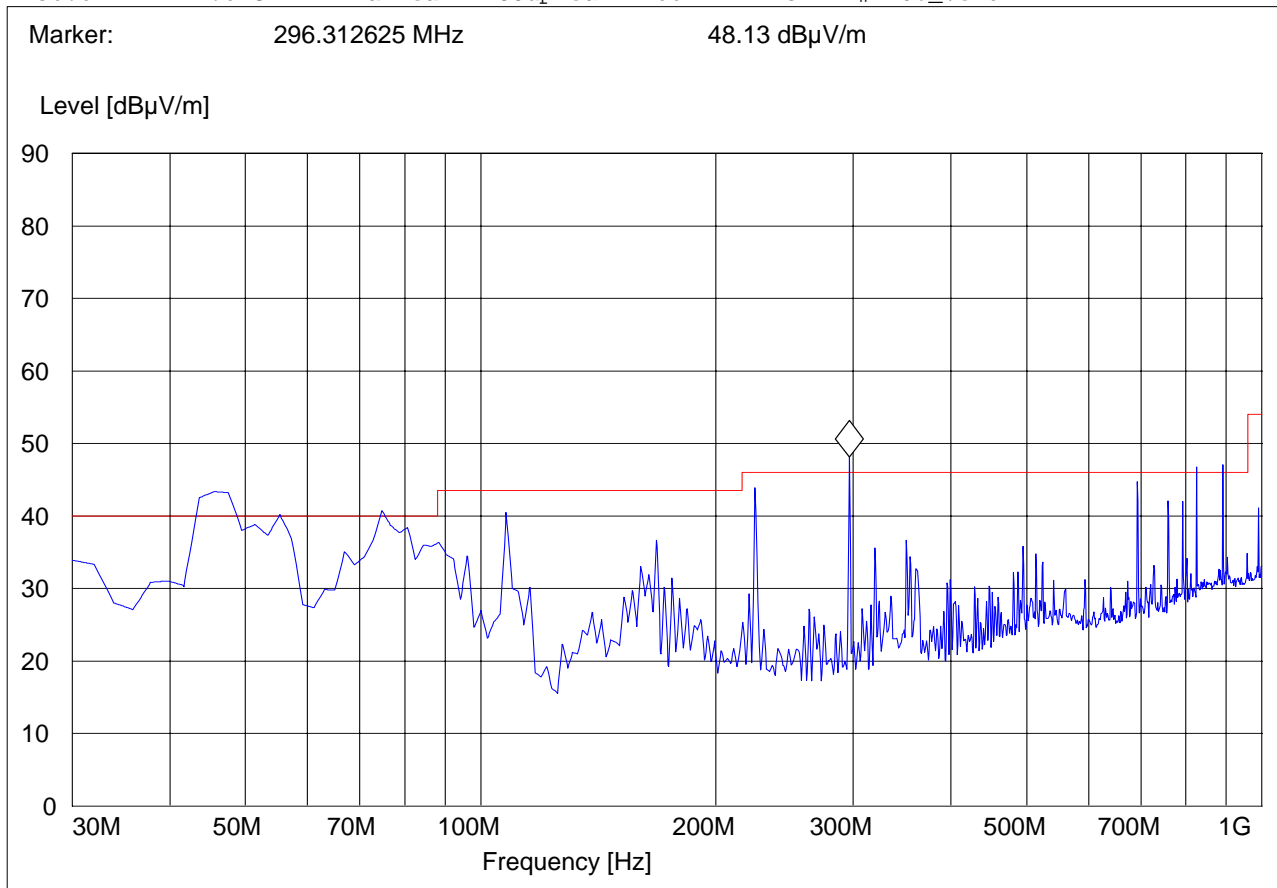
30MHz – 1GHz Antenna: Vertical.

Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_30M-1G_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert



The spurious emission over the limits is demonstrated not from the Bluetooth transceiver itself. The car stereo itself is an exempted device per FCC rule 15.103(a). See the plot following that this emission remained the same with the Bluetooth transceiver turned off.



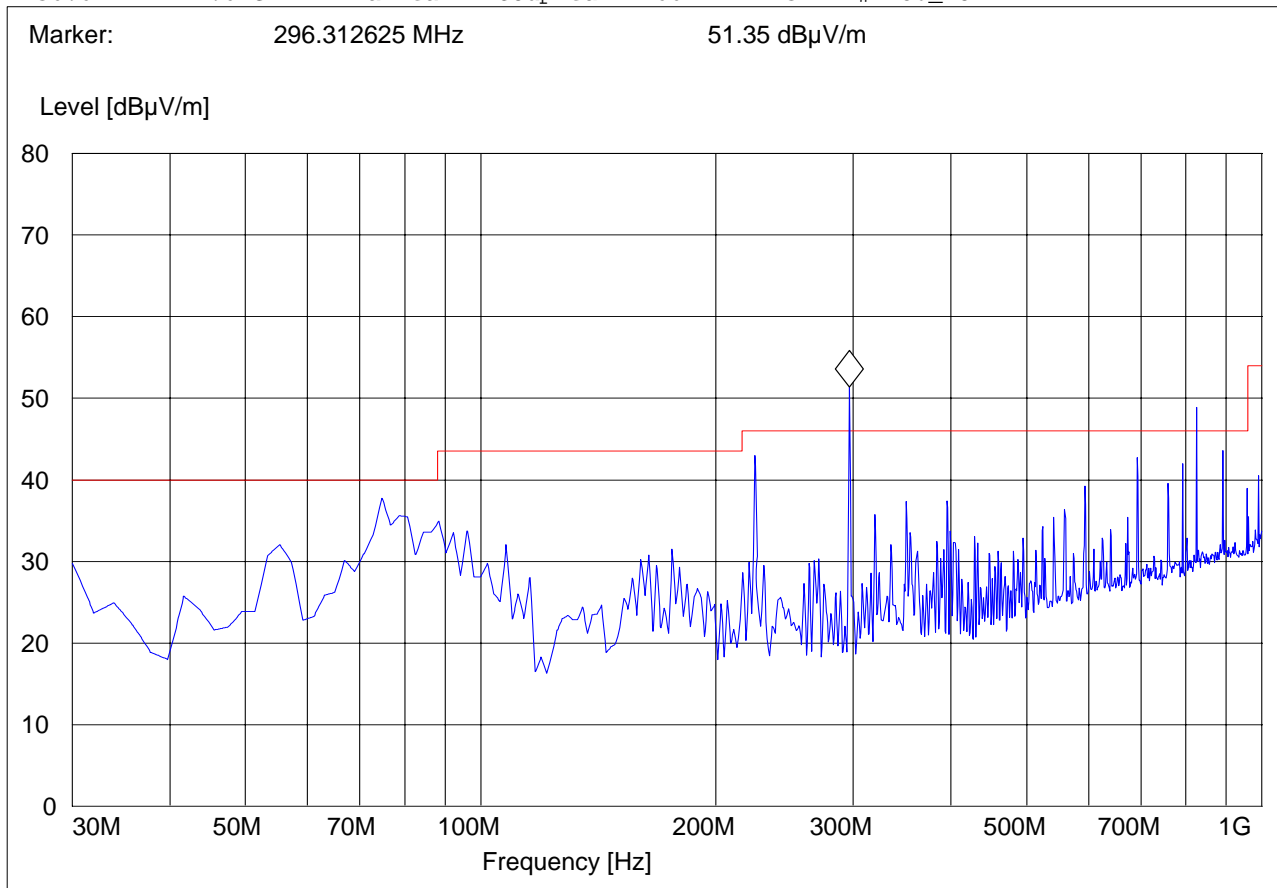
30MHz – 1GHz Antenna: horizontal.

Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_30M-1G_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz



The spurious emission over the limits is demonstrated not from the Bluetooth transceiver itself. The car stereo itself is an exempted device per FCC rule 15.103(a). See the plot following that this emission remained the same with the Bluetooth transceiver turned off.



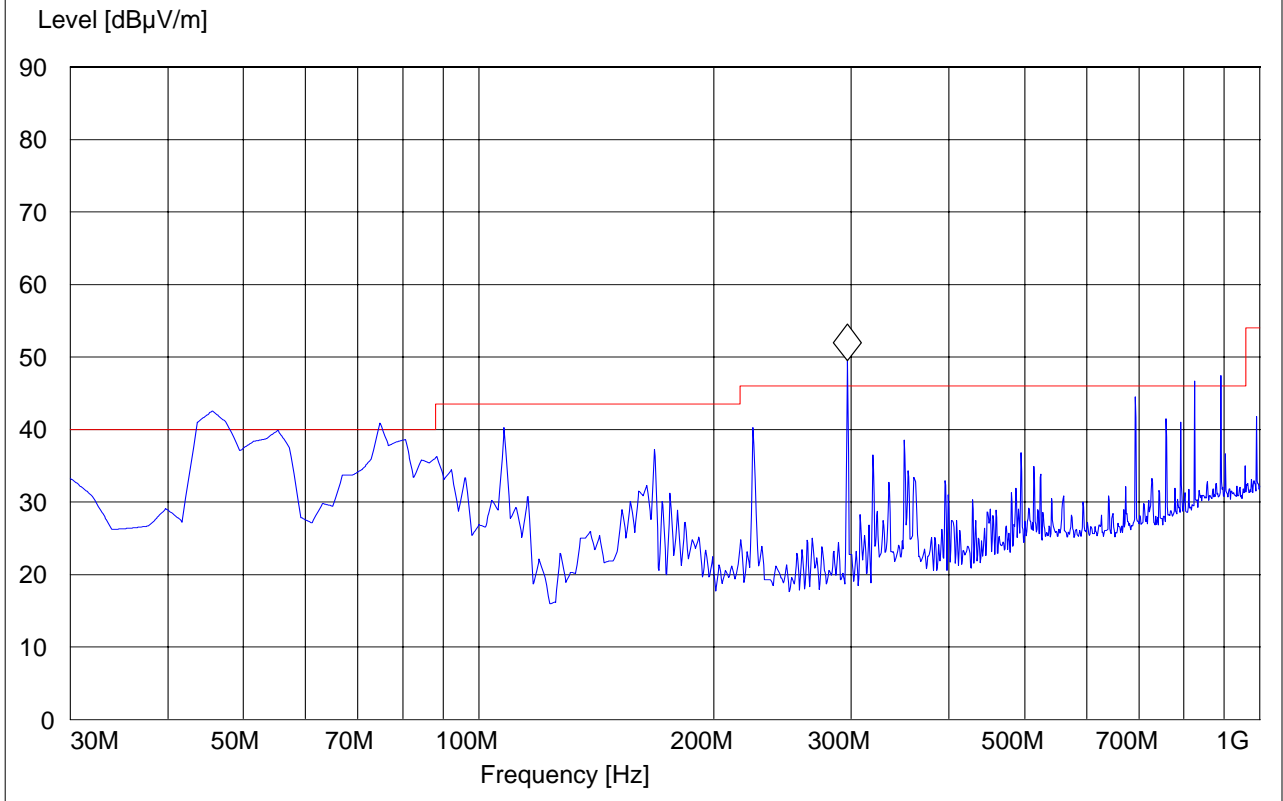
30MHz – 1GHz Antenna: Vertical. Bluetooth radio disabled
 Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments: BT RADIO DISABLED

SWEEP TABLE: "FCC15.247_30M-1G_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert

Marker: 296.312625 MHz 49.51 dBµV/m





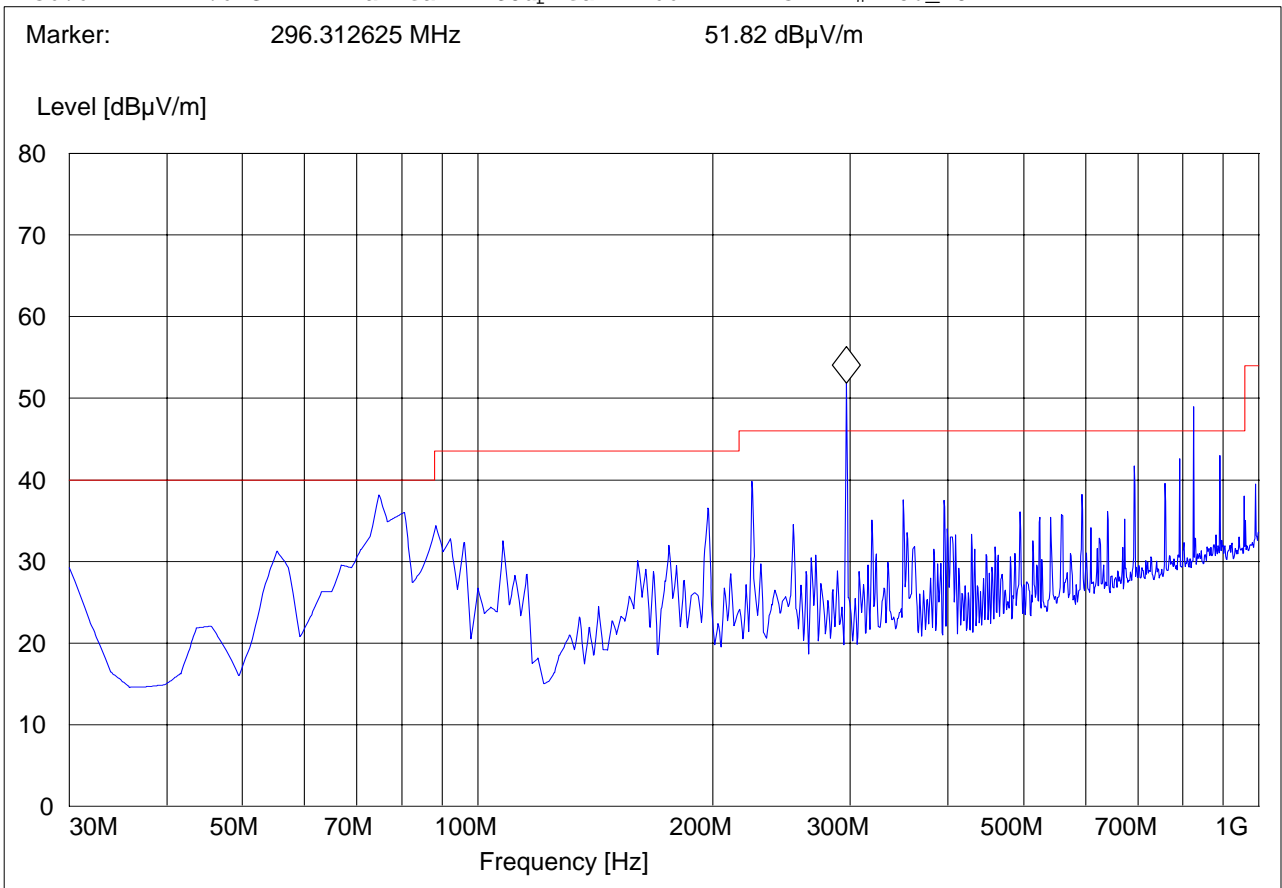
30MHz – 1GHz Antenna: horizontal. Bluetooth radio disabled
 Note: This plot is valid for low, mid, high channels (worst-case plot)

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: DC
 Comments: BT RADIO DISABLED

SWEEP TABLE: "FCC15.247_30M-1G_Horz"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz

Marker: 296.312625 MHz 51.82 dBµV/m



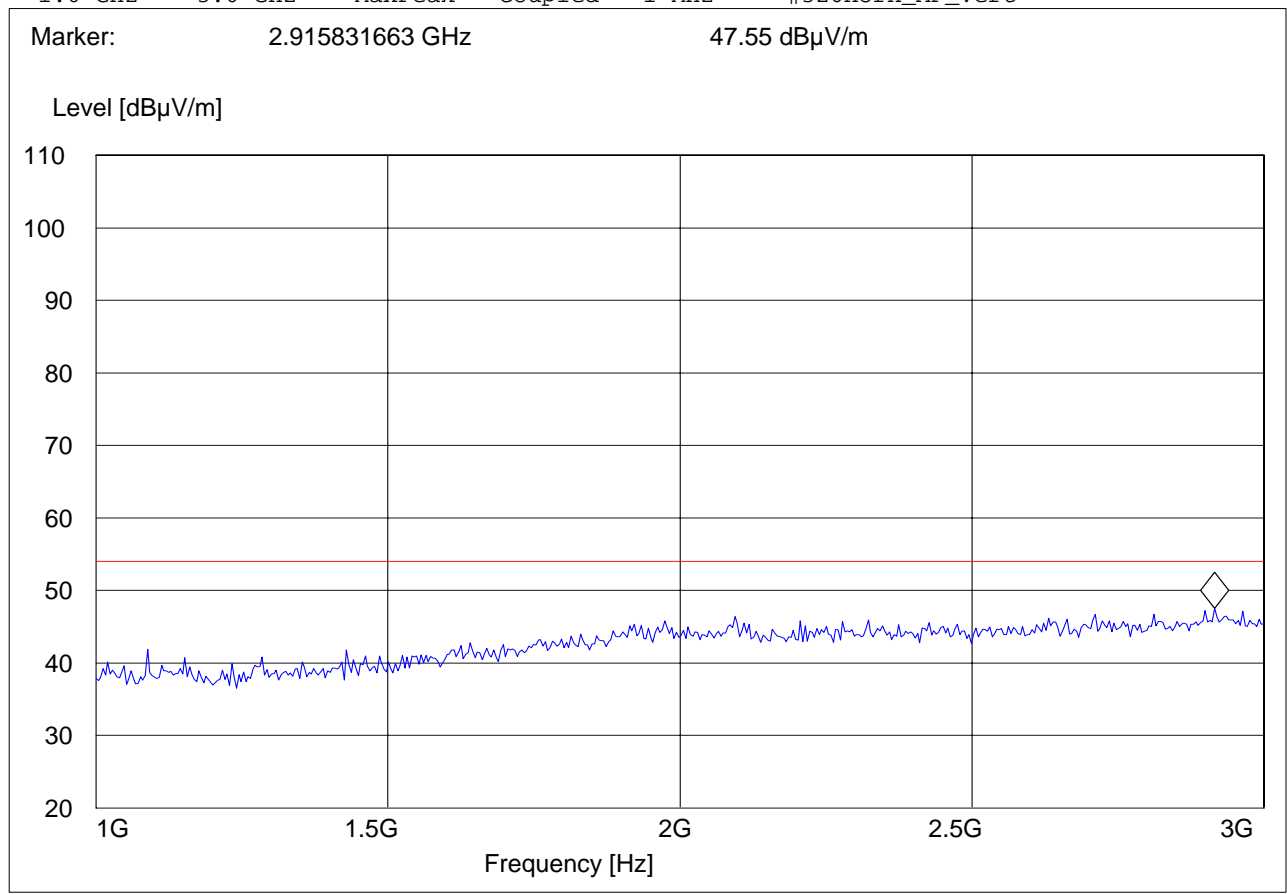


1-3GHz

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT Idle mode
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_1-3G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert





3-18GHz

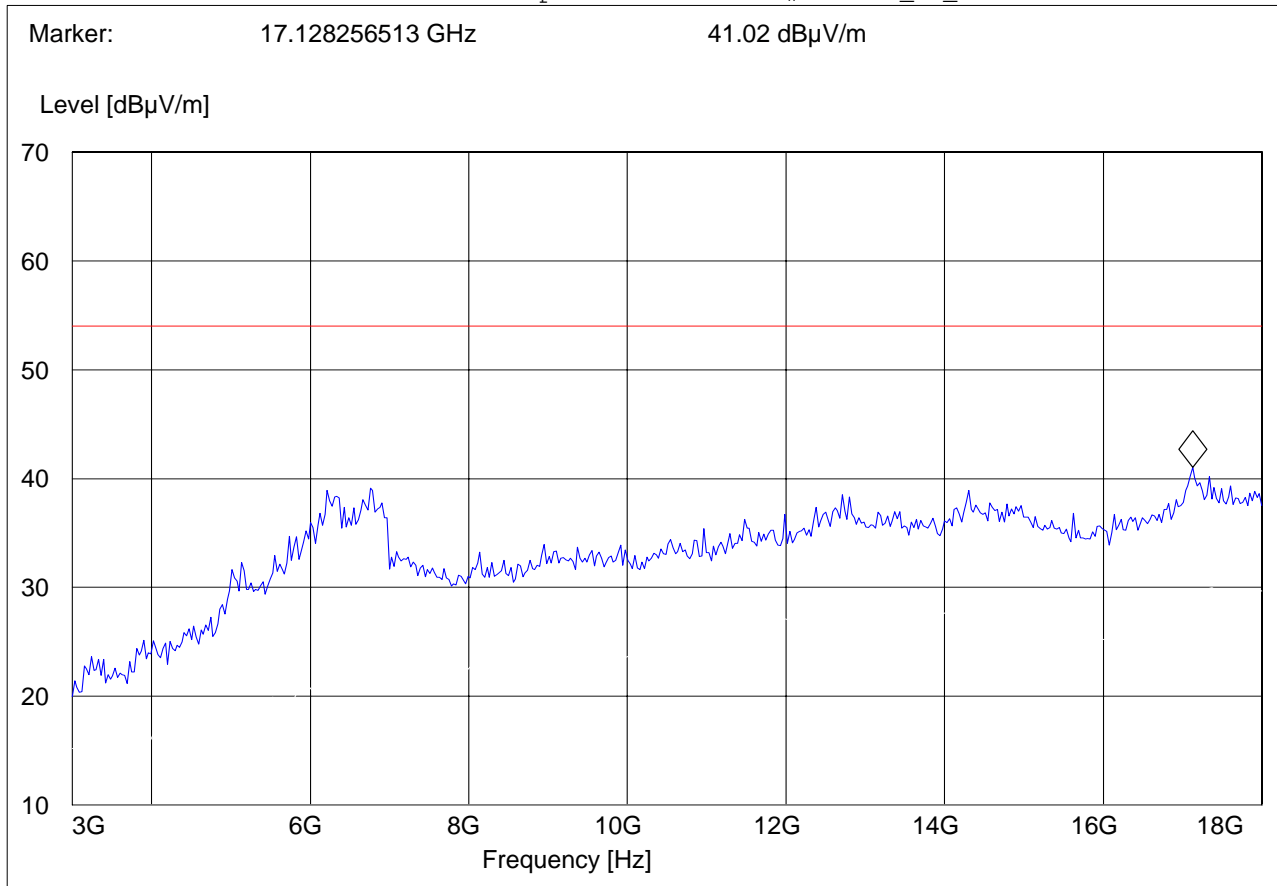
Note: This plot is valid for low, mid, high channels (worst-case plot) Note: Peak Reading vs.

Average limit

EUT: REU
 Customer:: Harman Becker
 Test Mode: BT Idle mode
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Satya
 Voltage: DC
 Comments:

SWEEP TABLE: "FCC15.247_3-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert





6 Measurements (CONDUCTED)

6.1 MAXIMUM PEAK OUTPUT POWER § 15.247 (CONDUCTED)

6.1.1 LIMIT SUB CLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	30dBm

*limit is based upon antenna gain of less than or equal to 6dBi.

6.1.2 Test Setting

BRW=VBW=3MHz

6.1.3 RESULTS: GFSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402 MHz	2441 MHz	2480 MHz
T _{nom} (23)°C	V _{nom} VDC	4.9	4.8	4.4

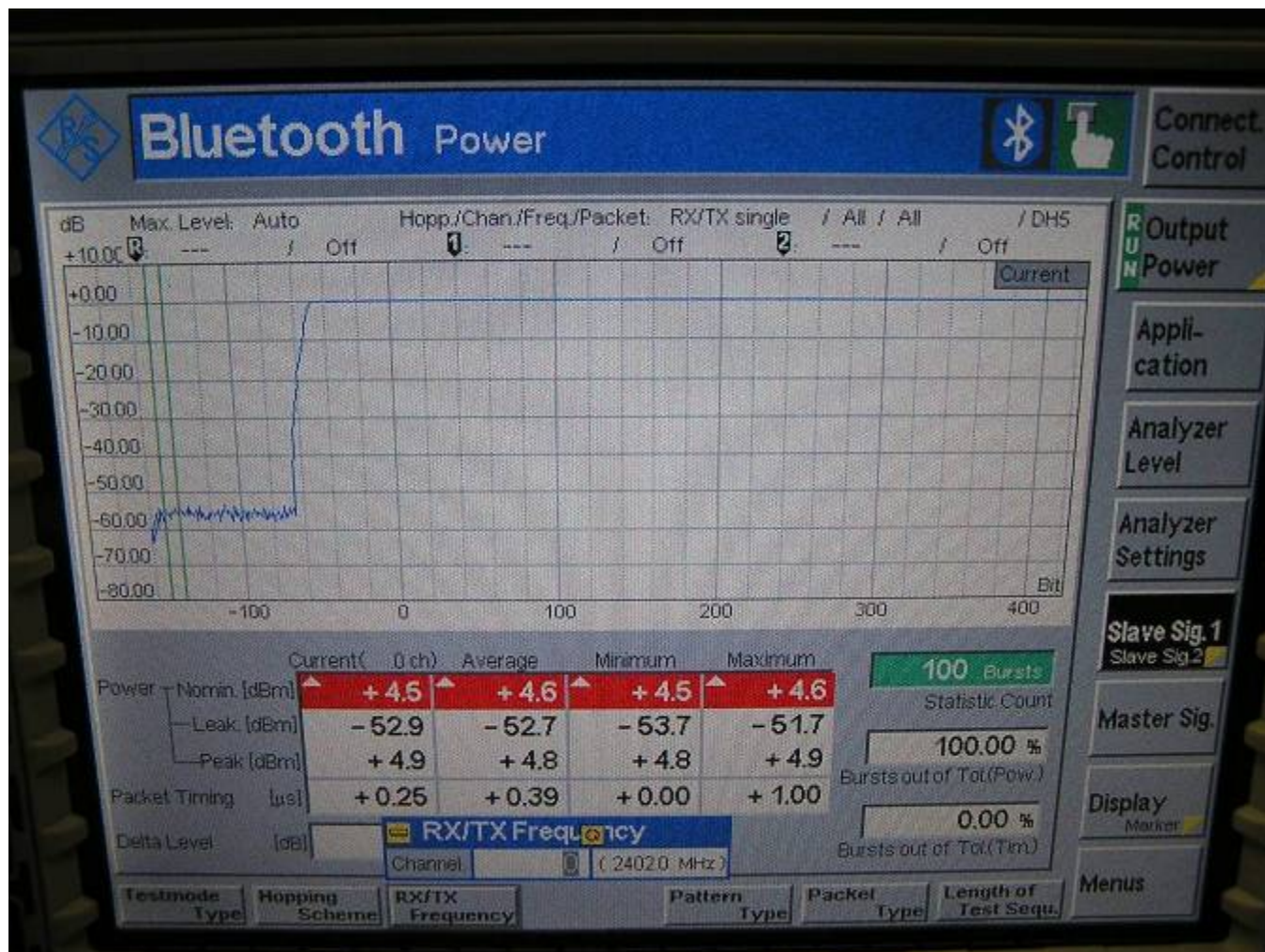
6.1.4 RESULTS: $\pi / 4$ DQPSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402 MHz	2441 MHz	2480 MHz
T _{nom} (23)°C	V _{nom} VDC	5.2	4.8	4.1

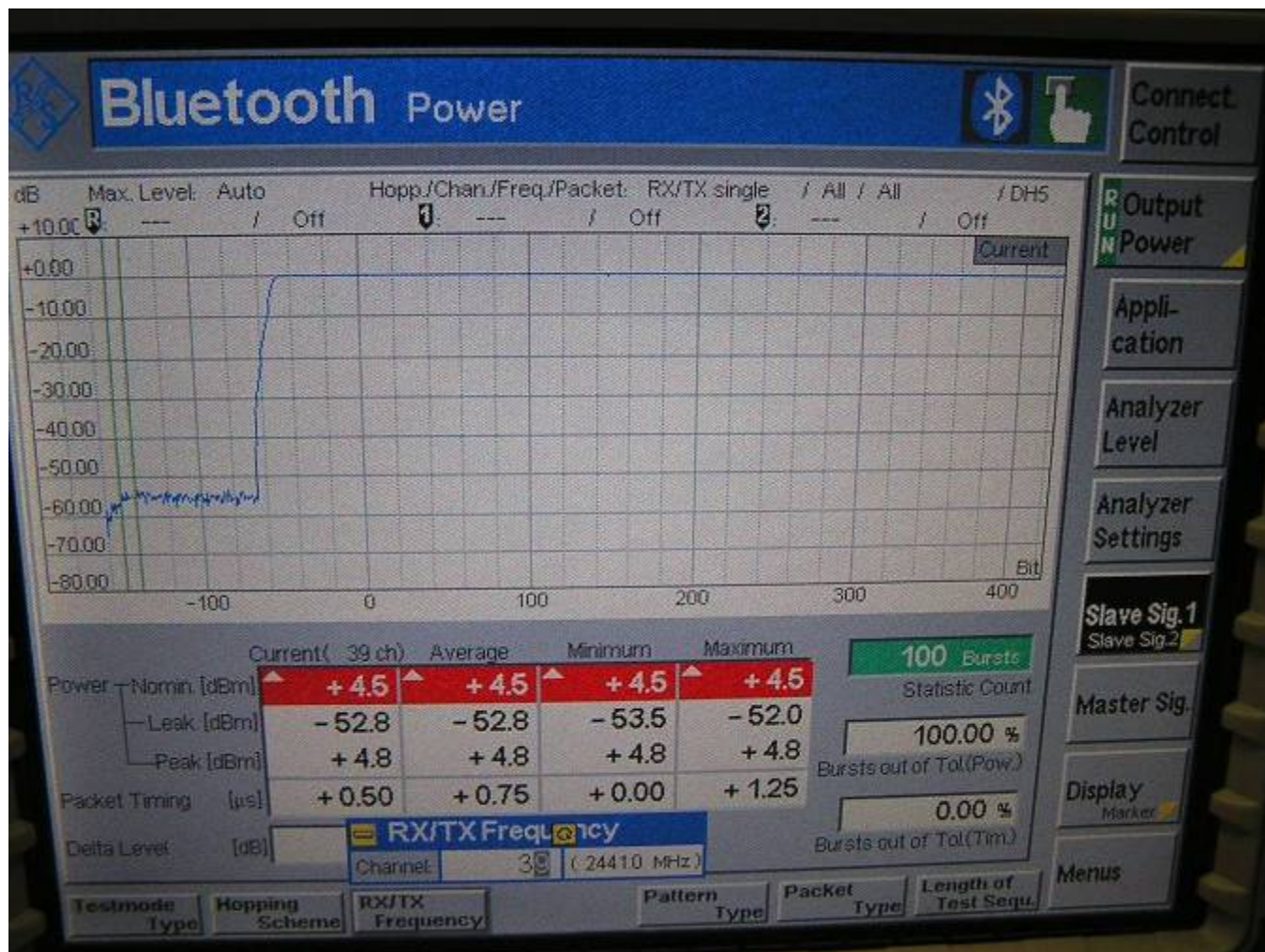
6.1.5 RESULTS: 8DPSK

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402 MHz	2441 MHz	2480 MHz
T _{nom} (23)°C	V _{nom} VDC	5.0	4.7	4.1

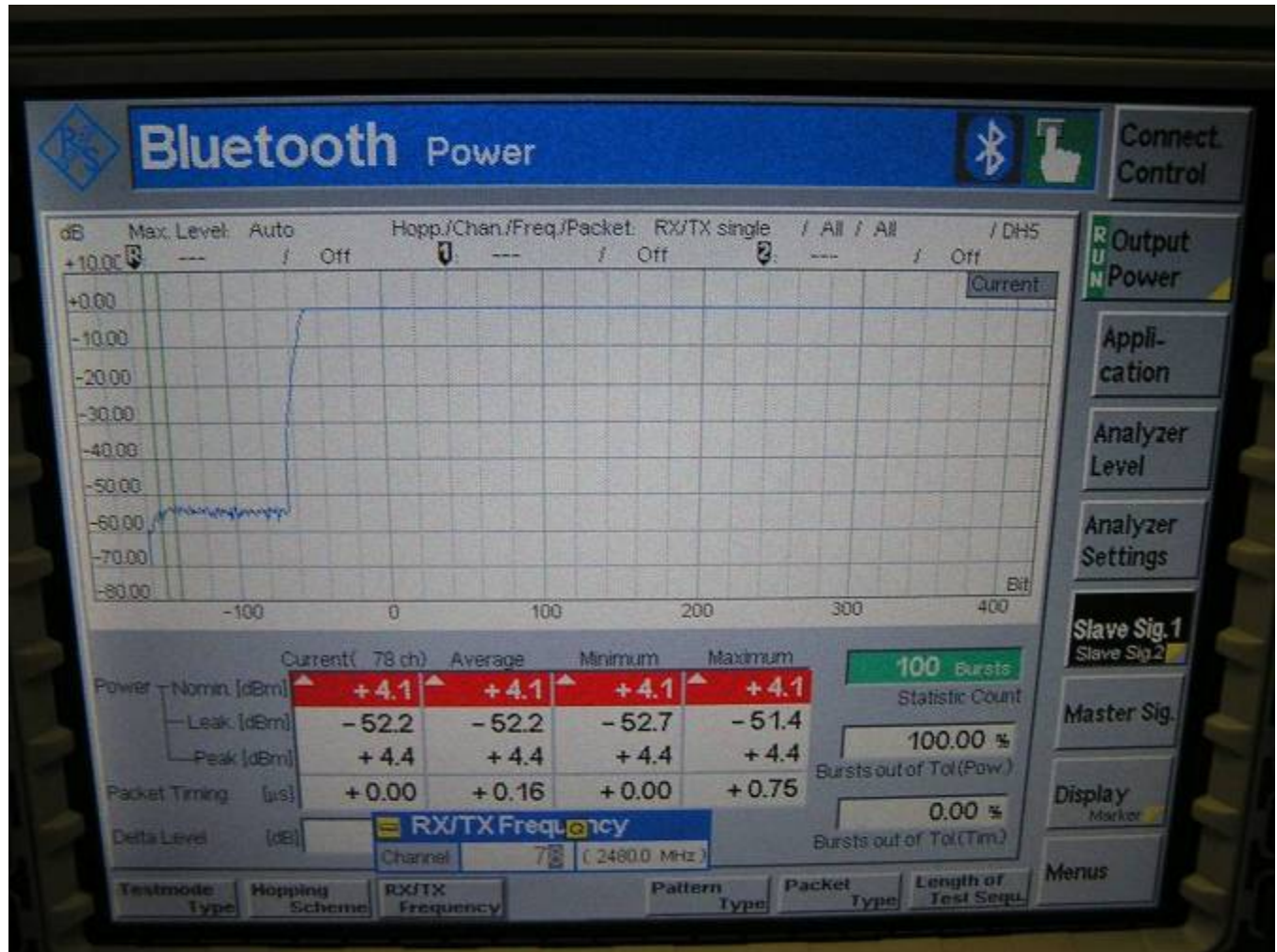
(2402 MHz) GFSK



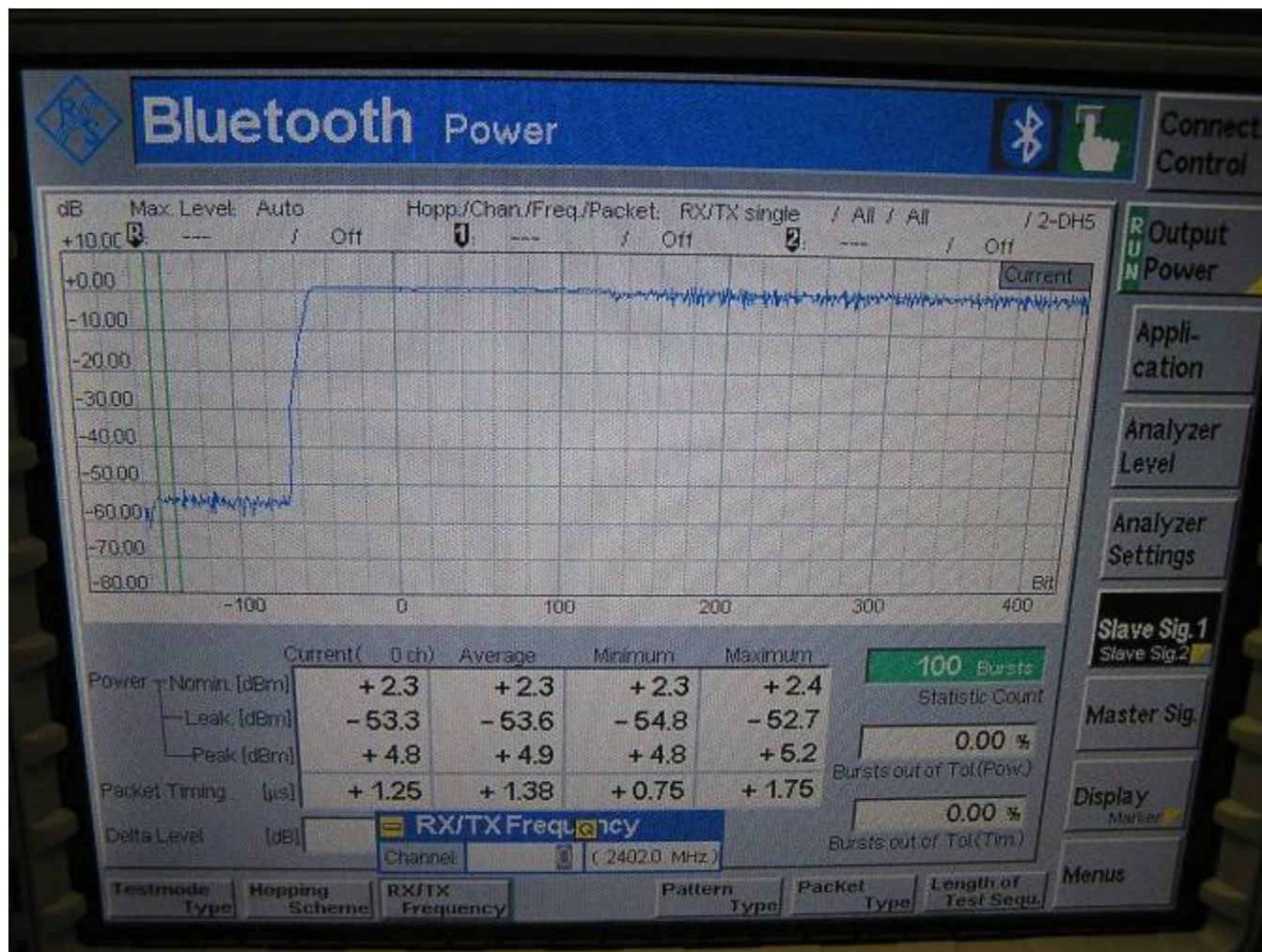
(2441 MHz) GFSK



(2480 MHz) GFSK

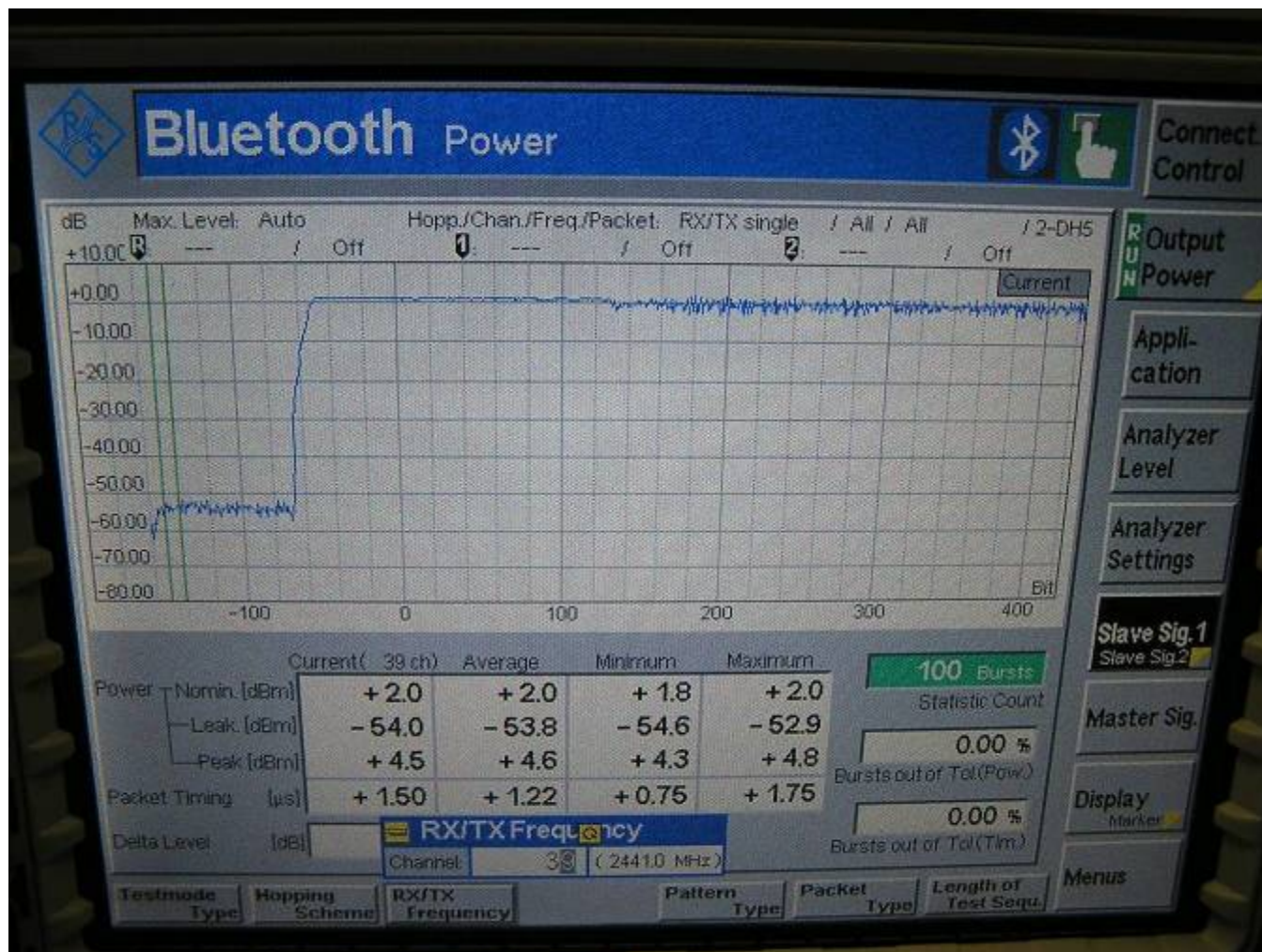


(2402 MHz) $\pi / 4$ DQPSK

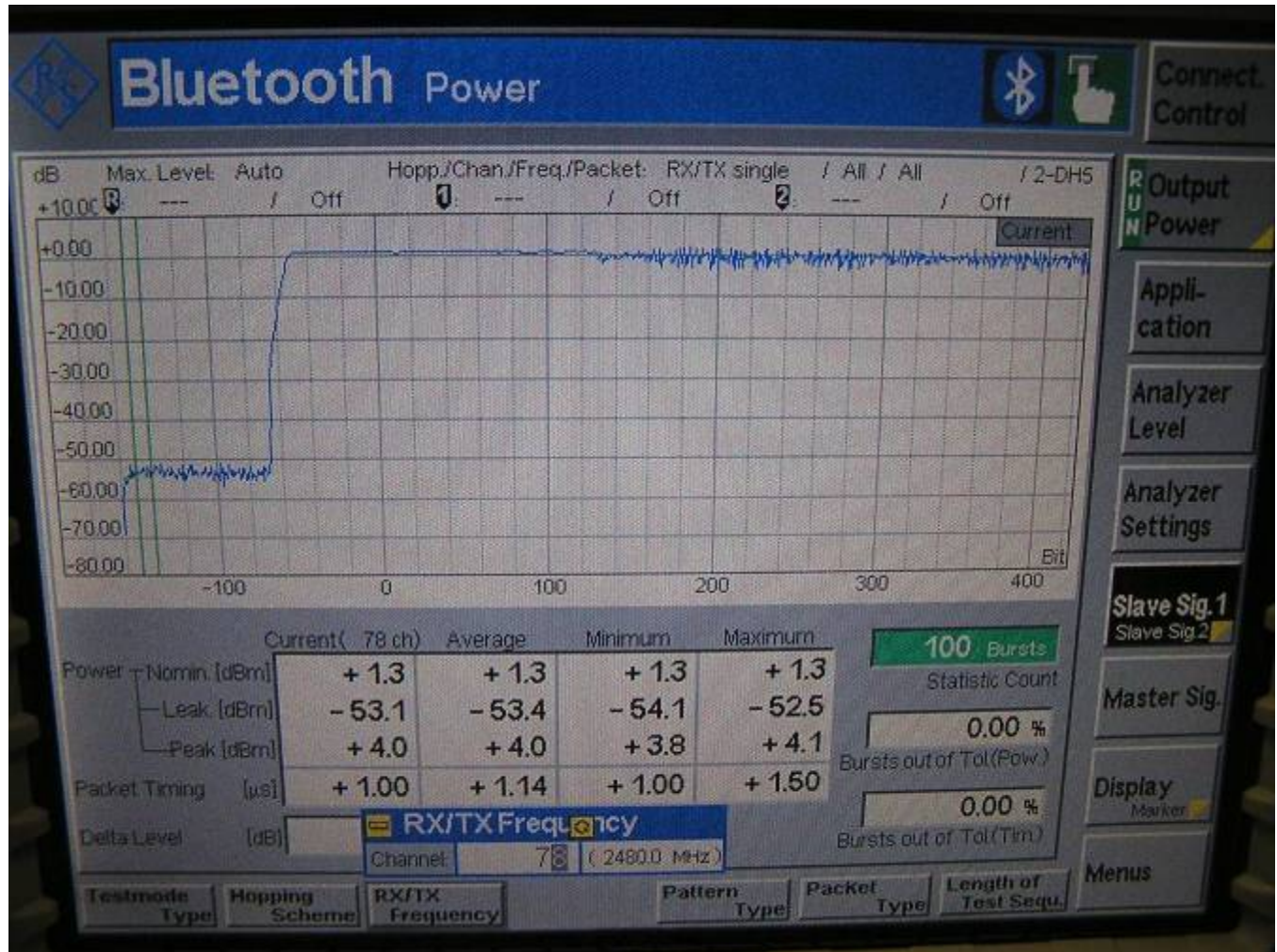




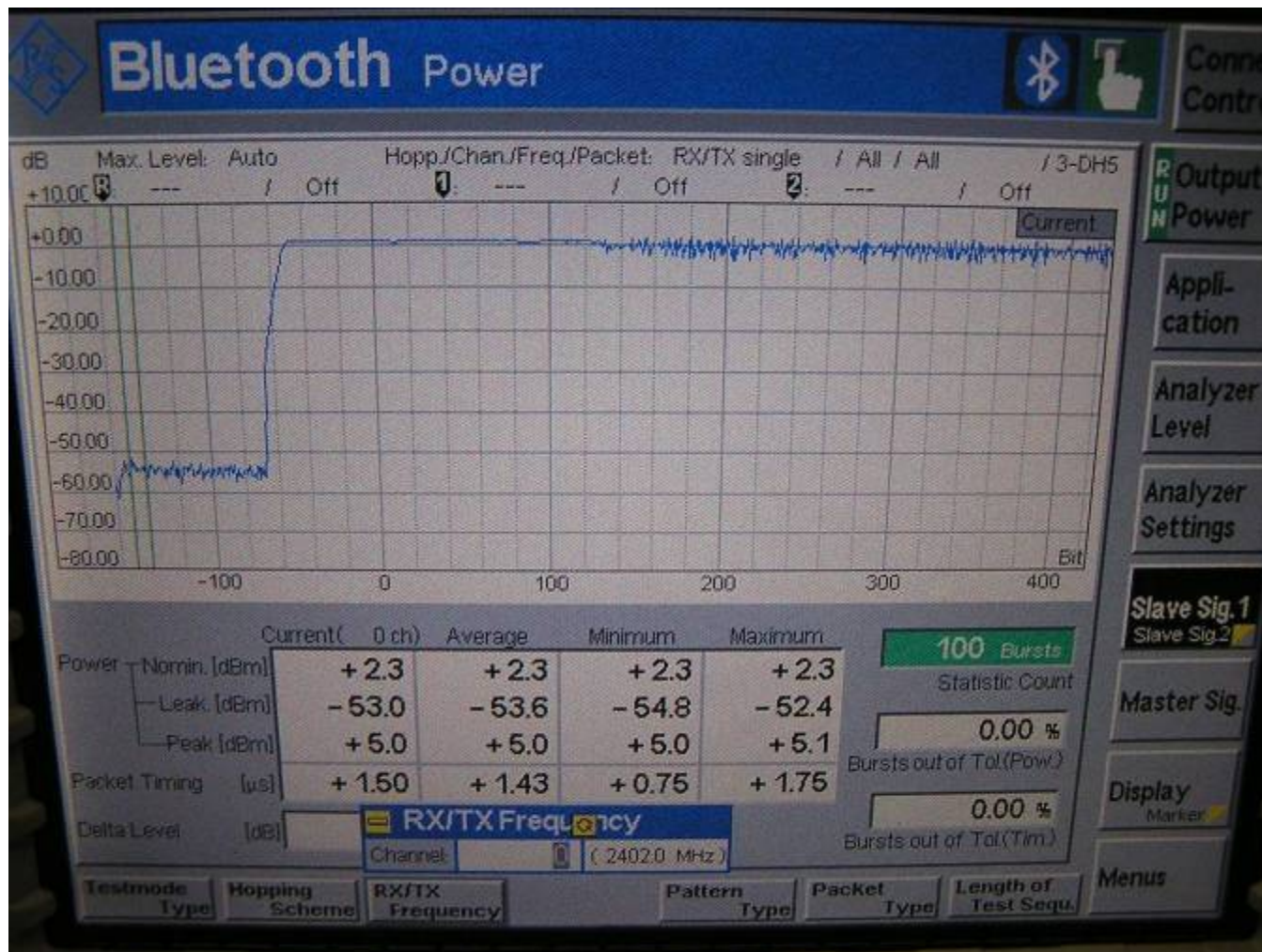
(2441 MHz) $\pi / 4$ DQPSK



(2480 MHz) $\pi / 4$ DQPSK

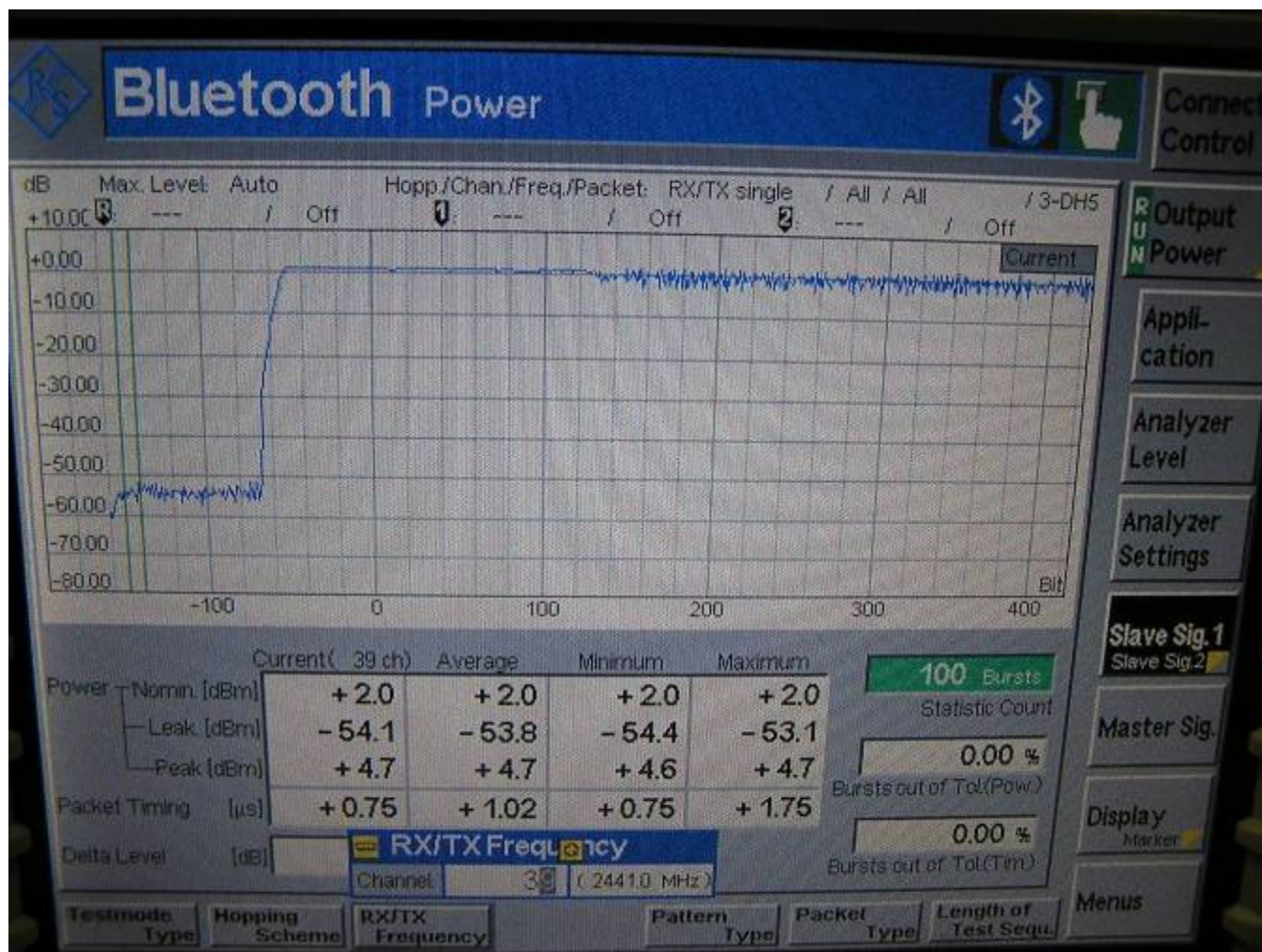


(2402 MHz) 8DPSK



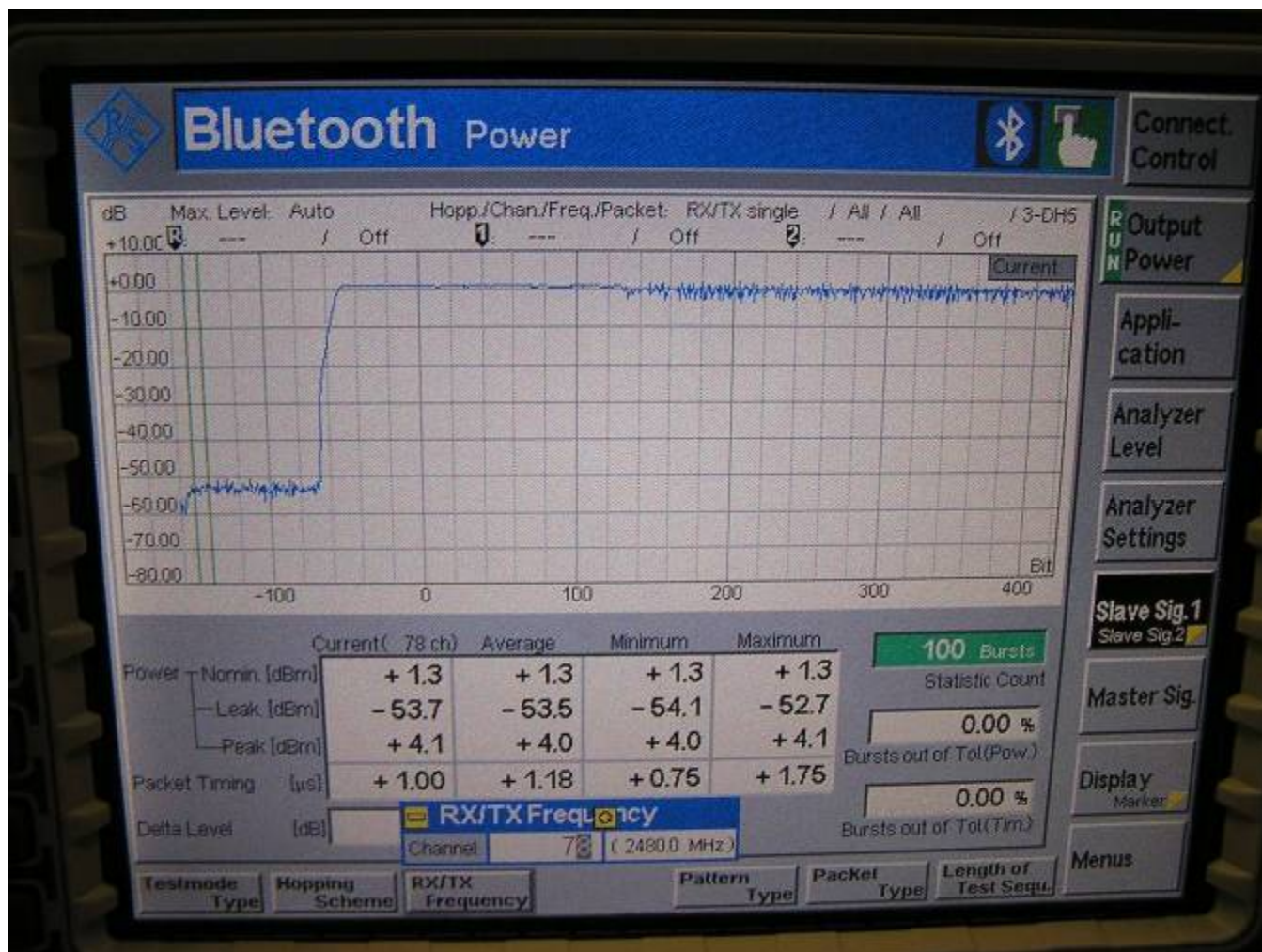


(2441 MHz) 8DPSK





(2480 MHz) 8DPSK





6.2 20dB BANDWIDTH

6.2.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.2.2 Test Setting:

RBW=VBW=10kHz

6.2.3 RESULTS: GFSK

TEST CONDITIONS		BANDWIDTH (KHz)		
		2402 MHz	2441 MHz	2480 MHz
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} VDC	840	840	839

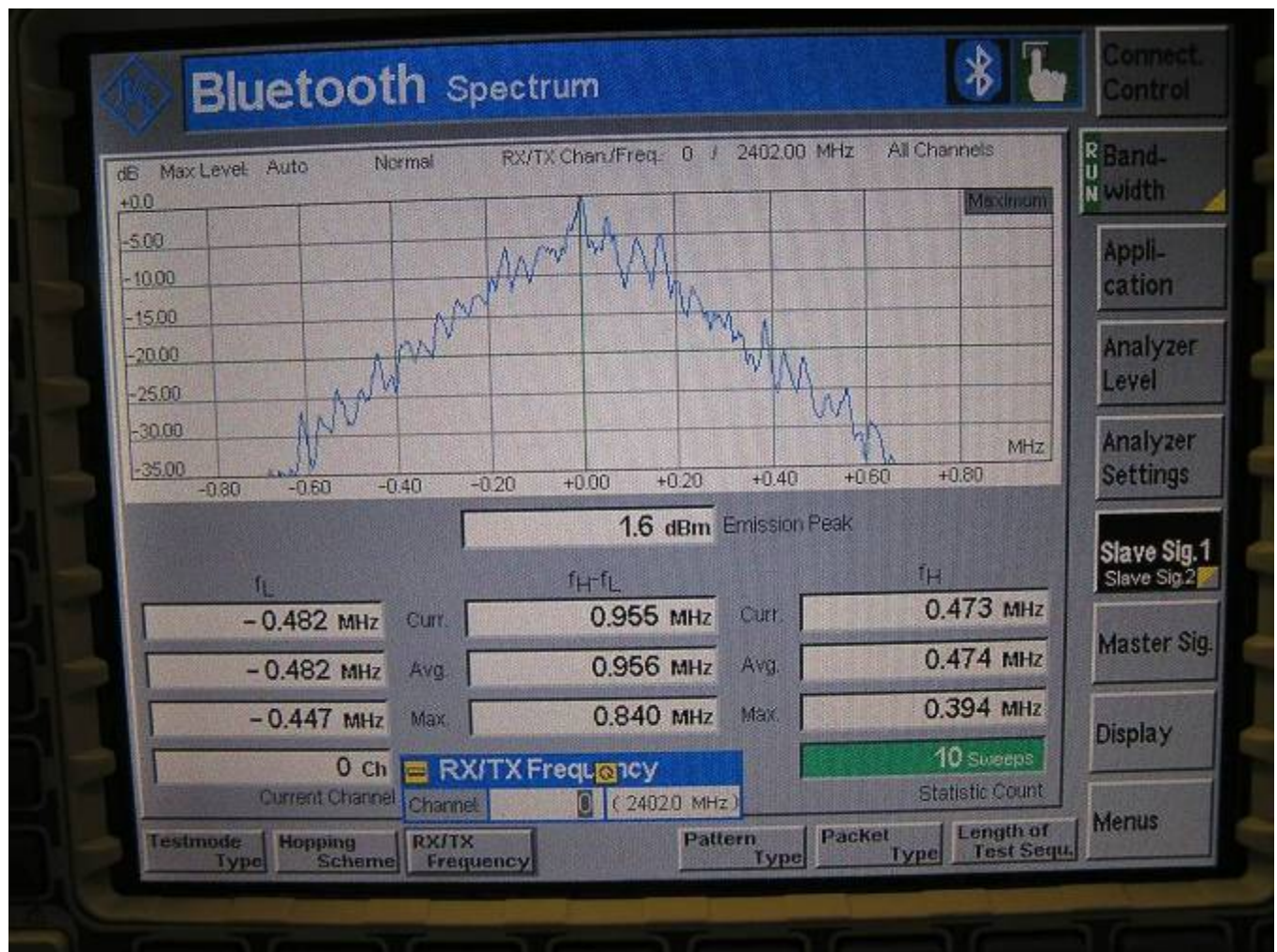
6.2.4 RESULTS: π / 4 DQPSK

TEST CONDITIONS		BANDWIDTH (KHz)		
		2402 MHz	2441 MHz	2480 MHz
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} VDC	1161	1161	1161

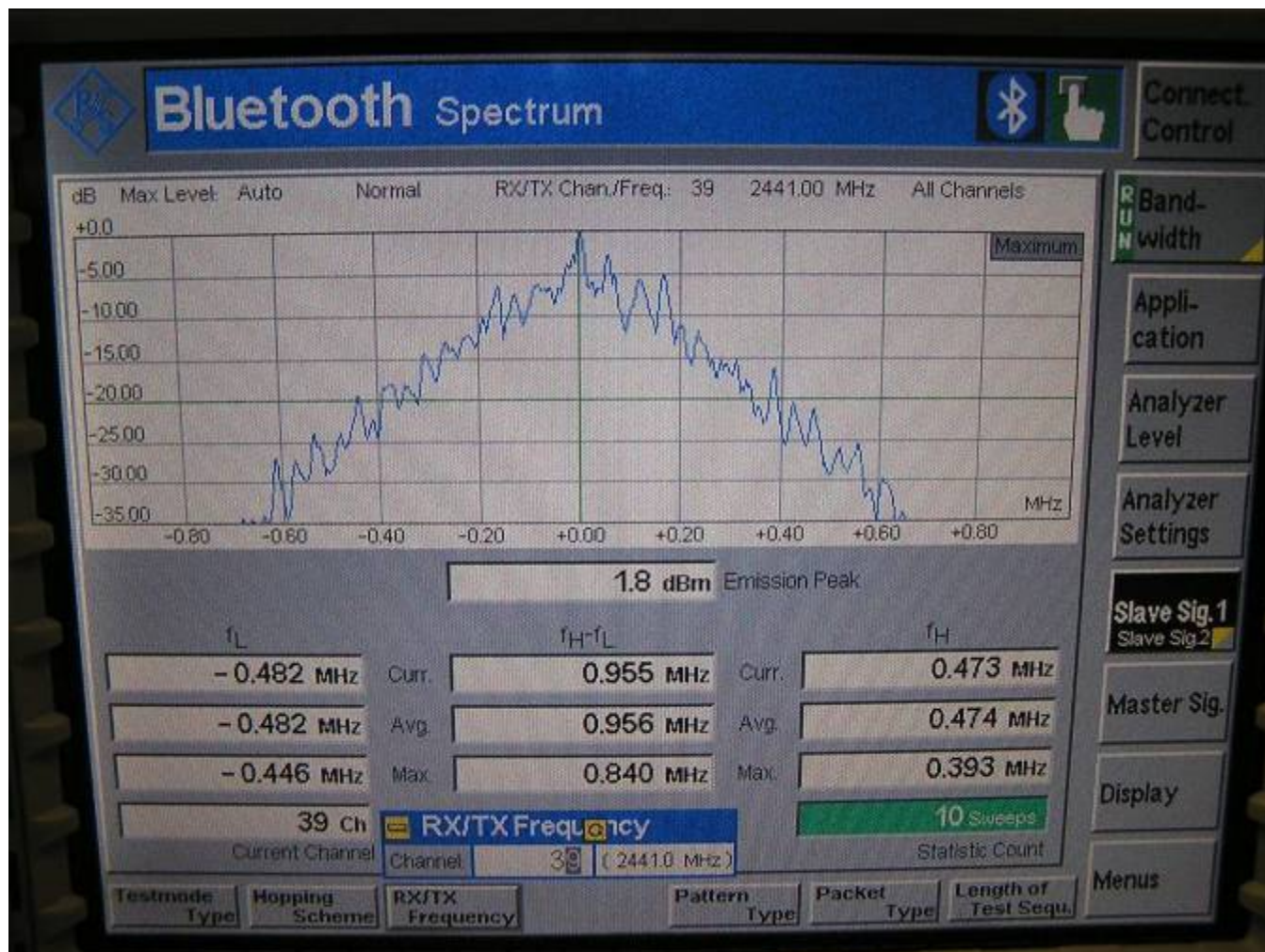
6.2.5 RESULTS: 8DPSK

TEST CONDITIONS		BANDWIDTH (KHz)		
		2402 MHz	2441 MHz	2480 MHz
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} VDC	1195	1194	1195

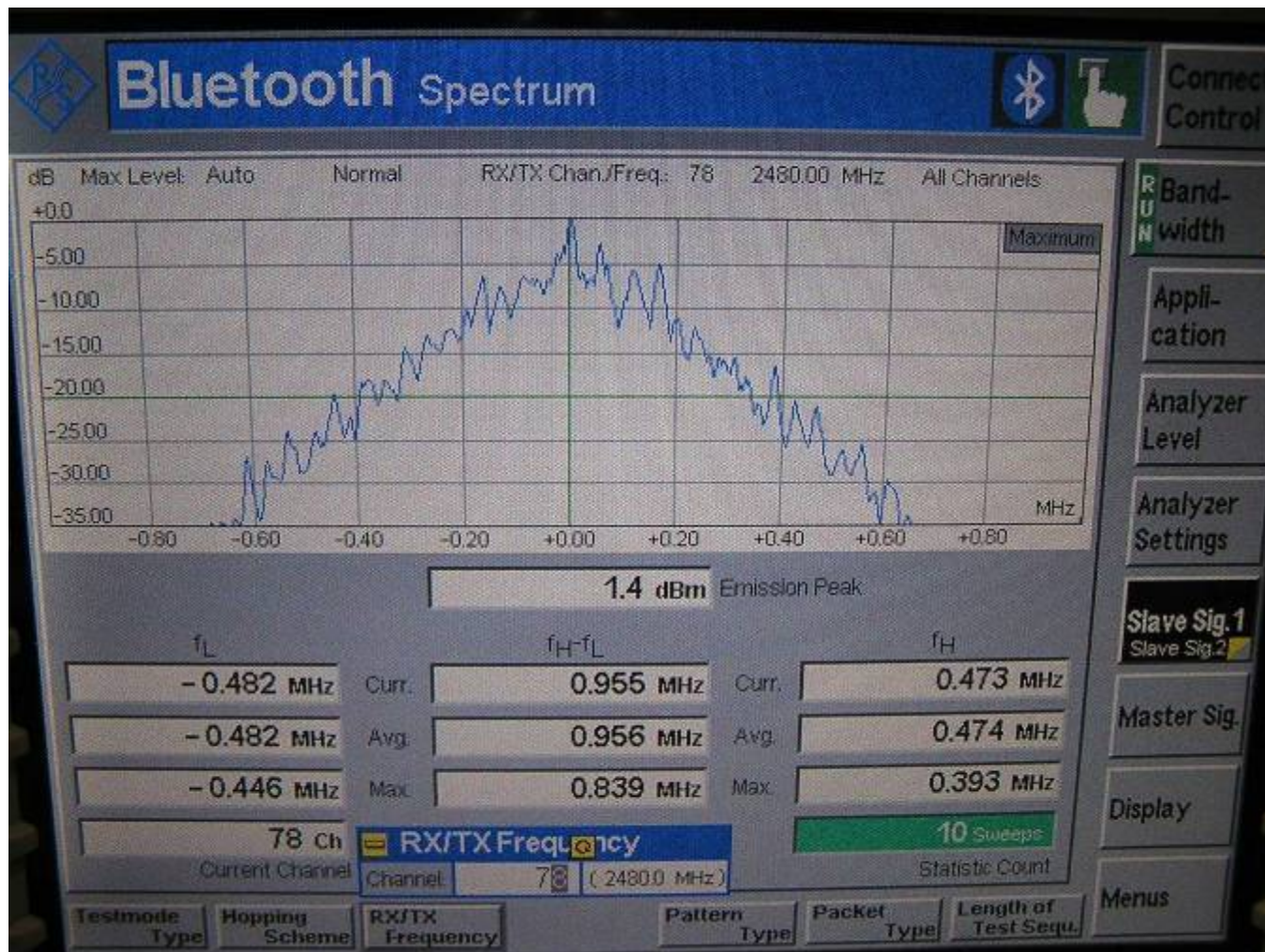
(2402 MHz) GFSK



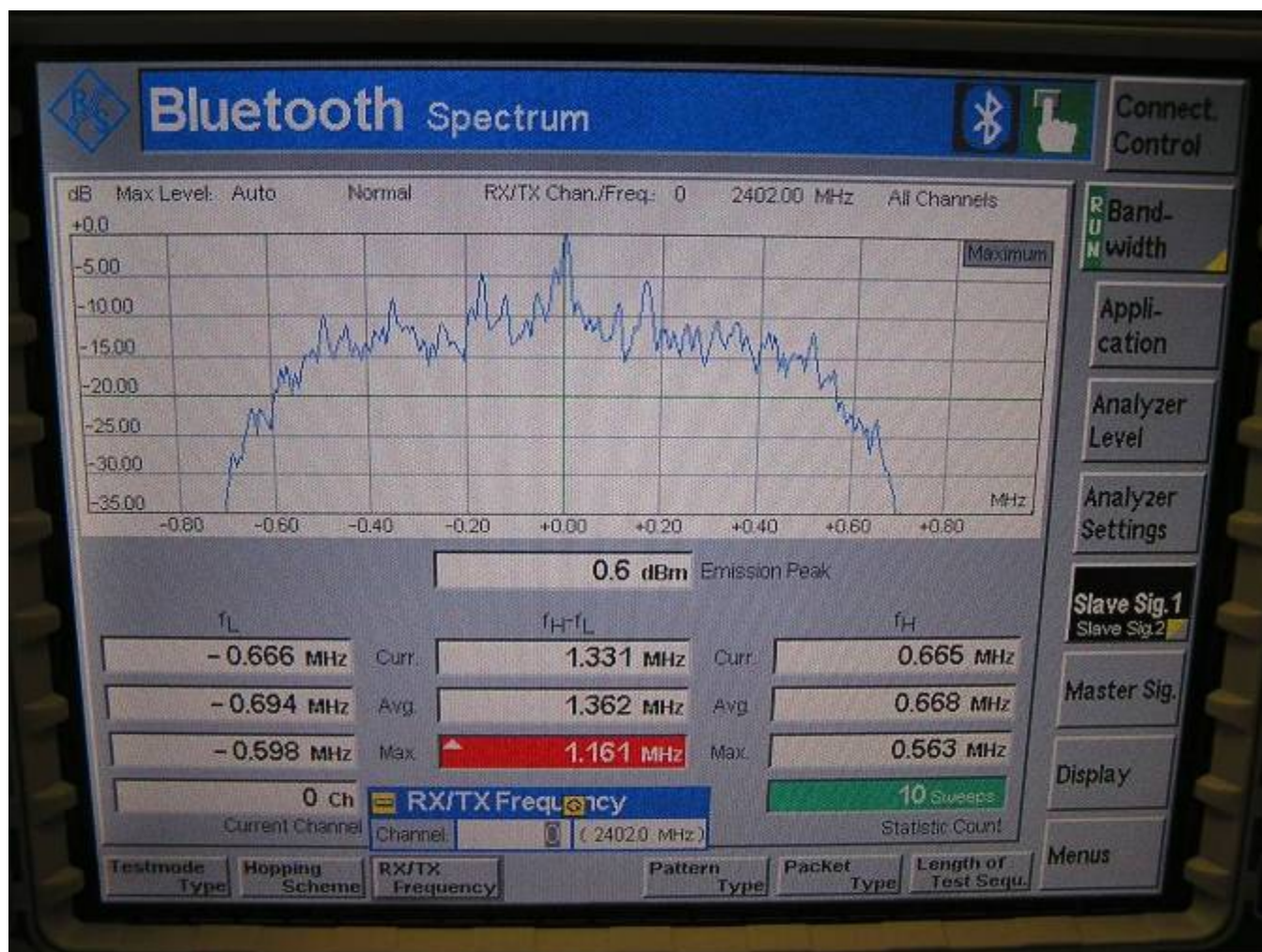
(2441 MHz) GFSK



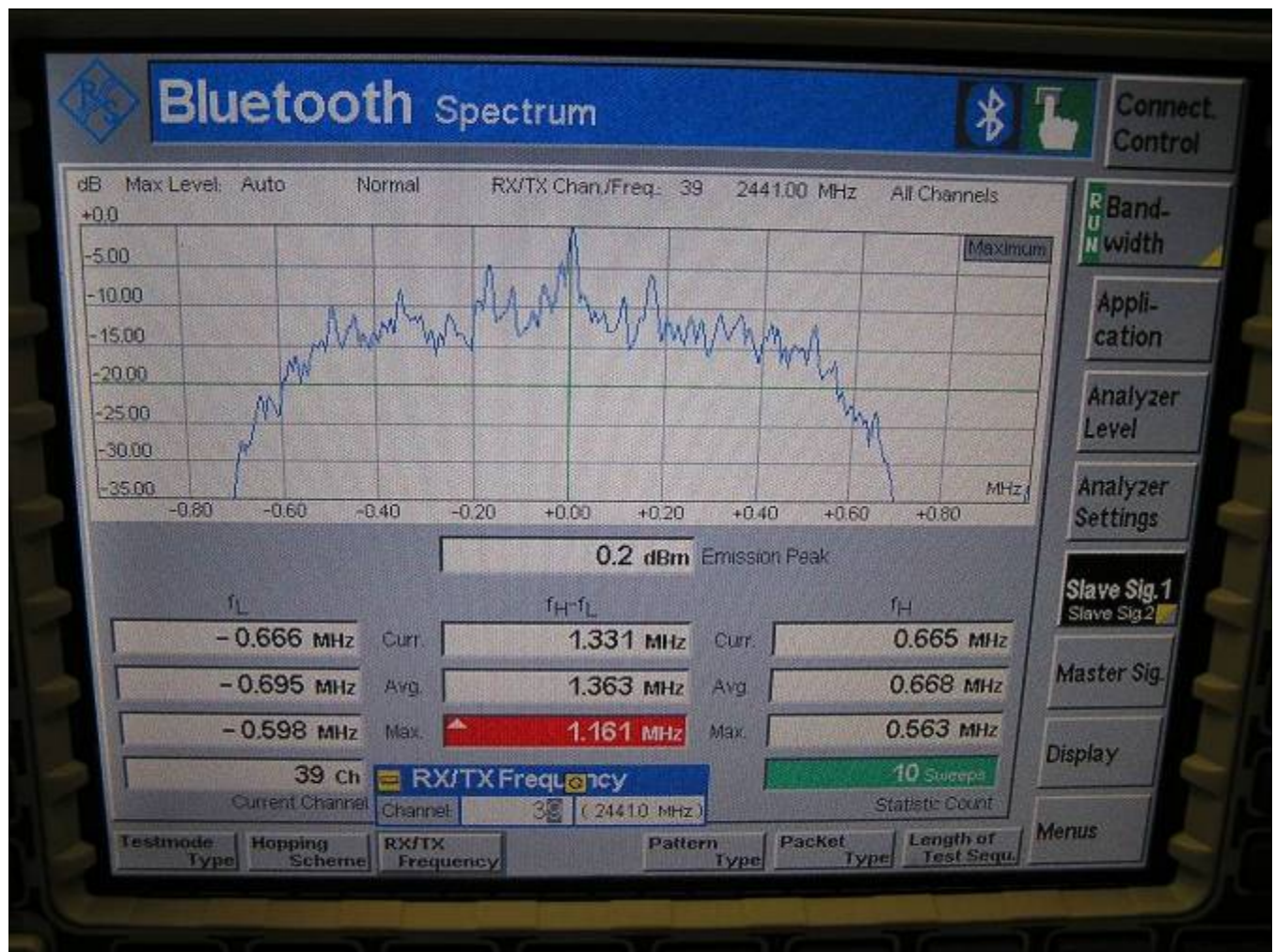
(2480 MHz) GFSK



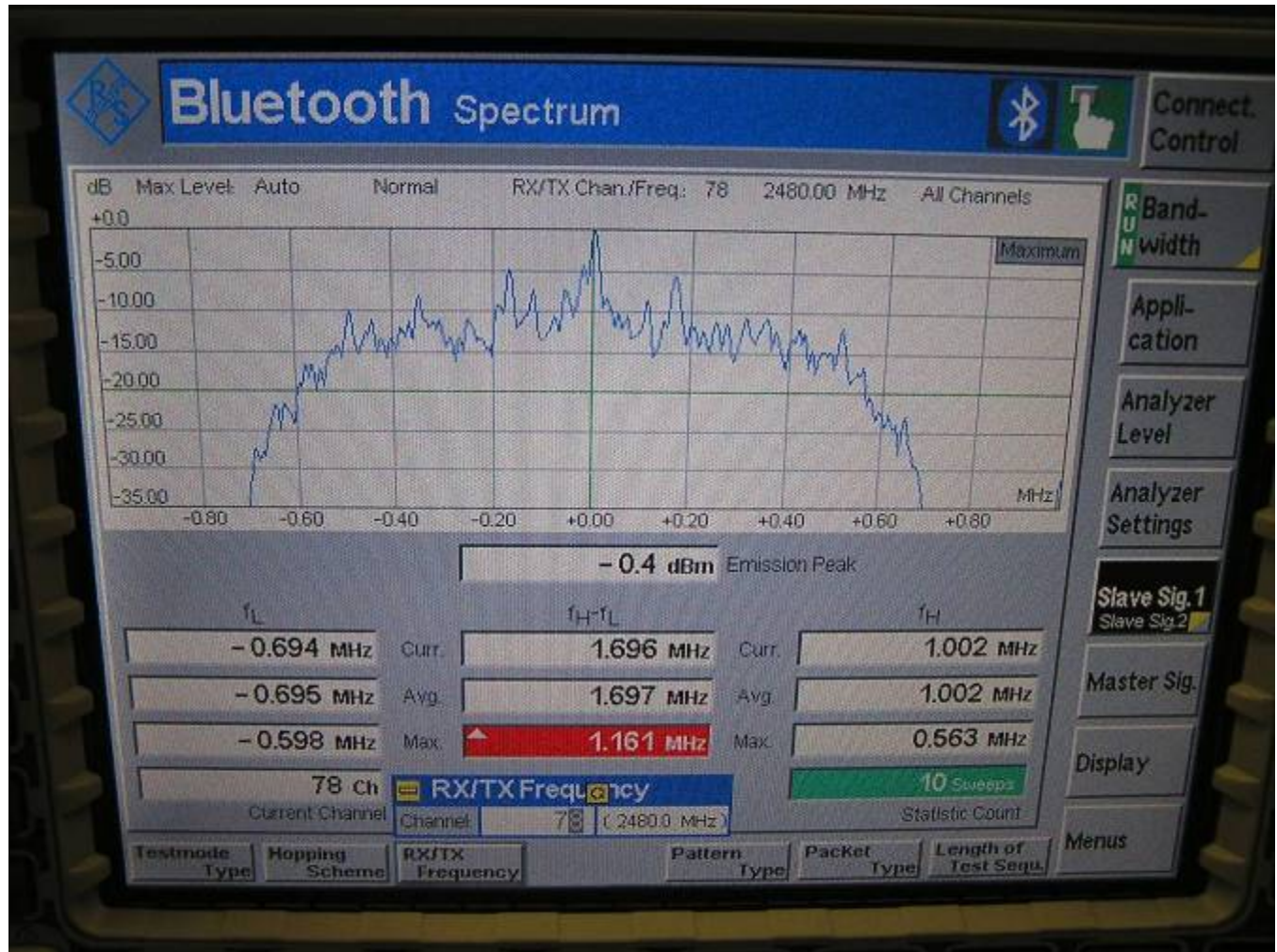
(2402 MHz) $\pi / 4$ DQPSK



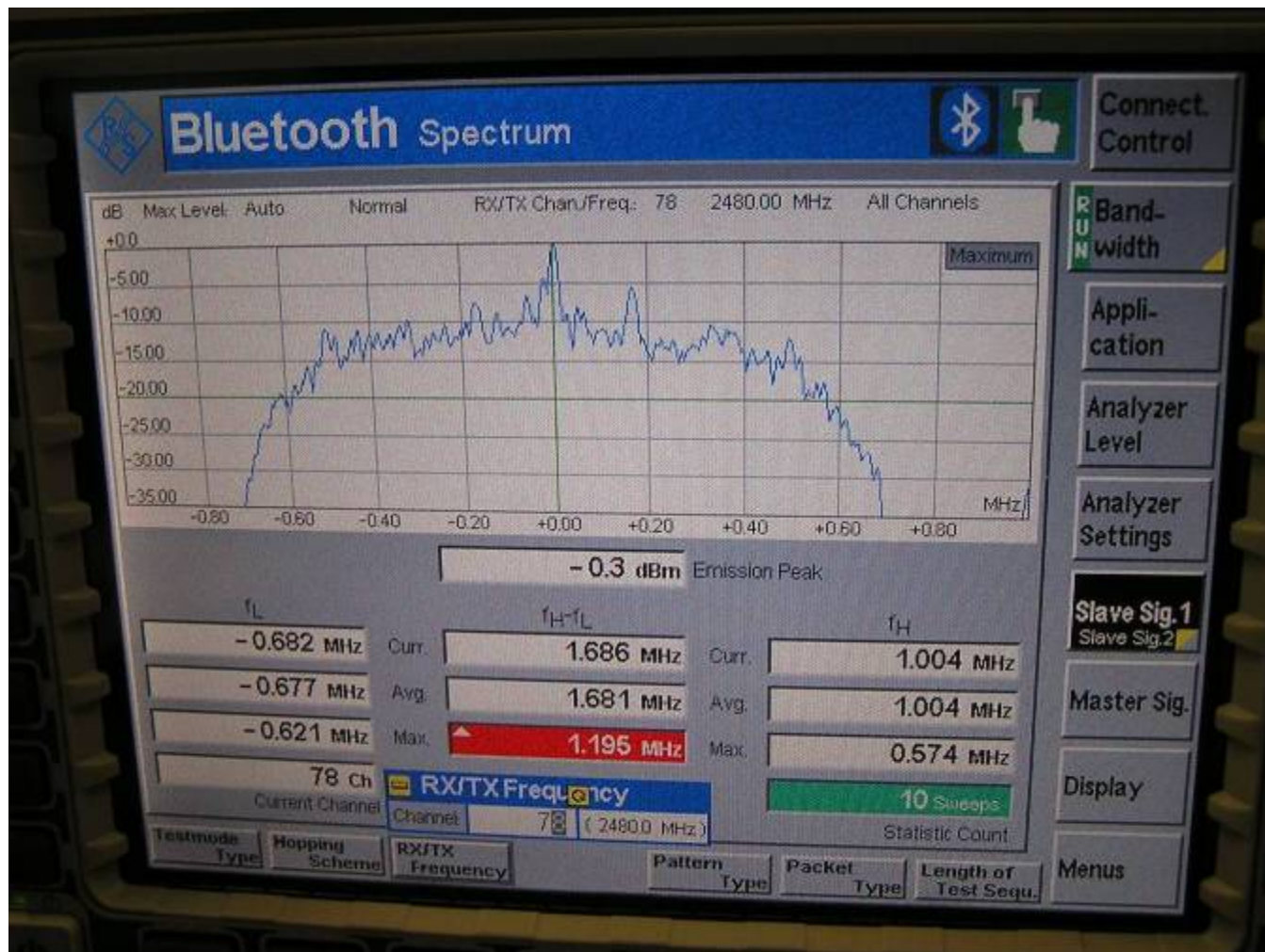
(2441 MHz) $\pi / 4$ DQPSK



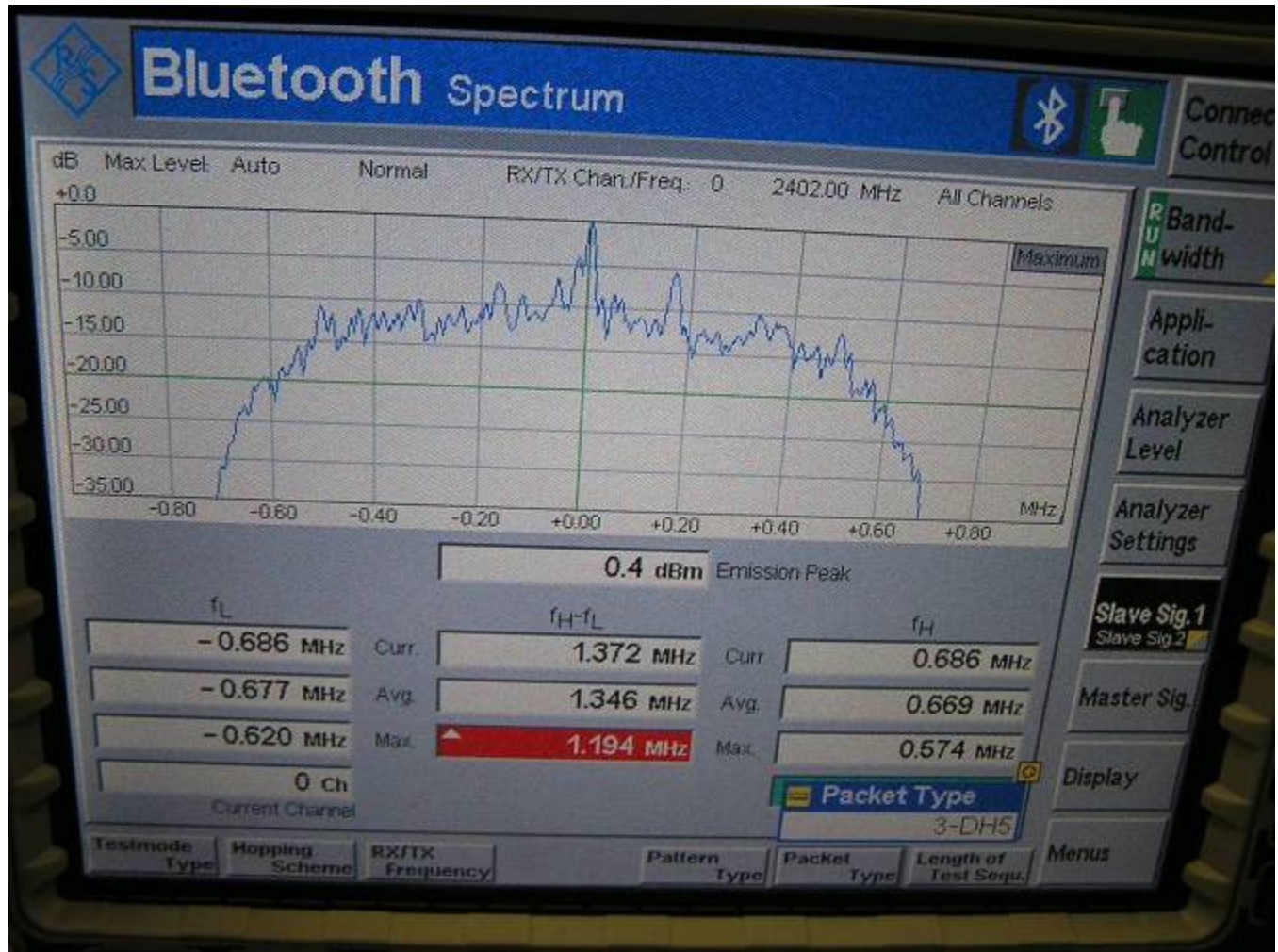
(2480 MHz) $\pi / 4$ DQPSK



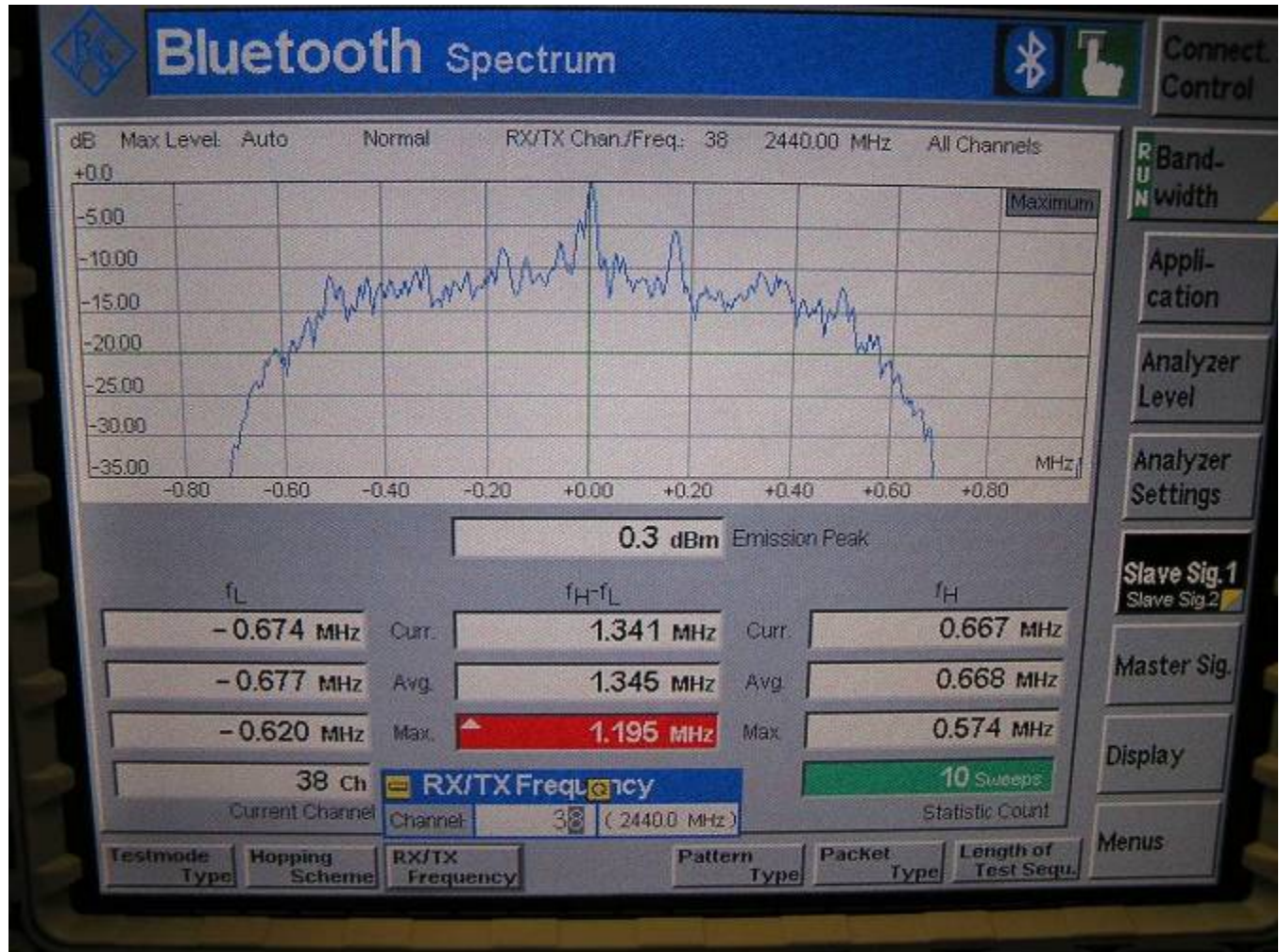
(2402 MHz) 8DPSK



(2441 MHz) 8DPSK



(2480 MHz) 8DPSK





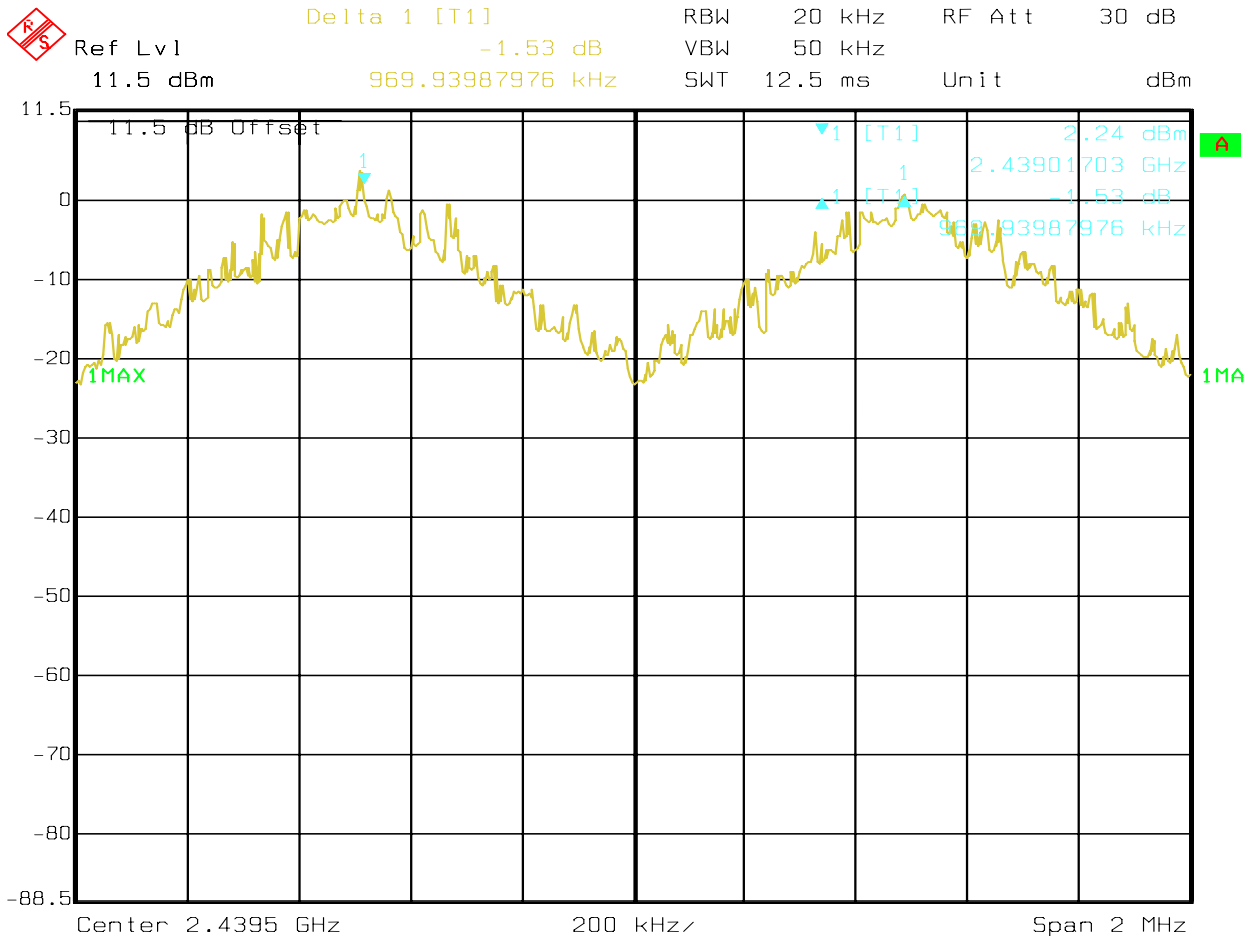
6.3 CARRIER FREQUENCY SEPARATION

6.3.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

SEPARATION
> 25 KHz or > 20 dB BANDWIDTH

6.3.2 RESULTS:

TEST CONDITIONS		SEPARATION (MHz)
T_{nom}(23)°C	V_{nom}VDC	0.969



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6.4 NUMBER OF HOPPING CHANNELS

6.4.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (iii)

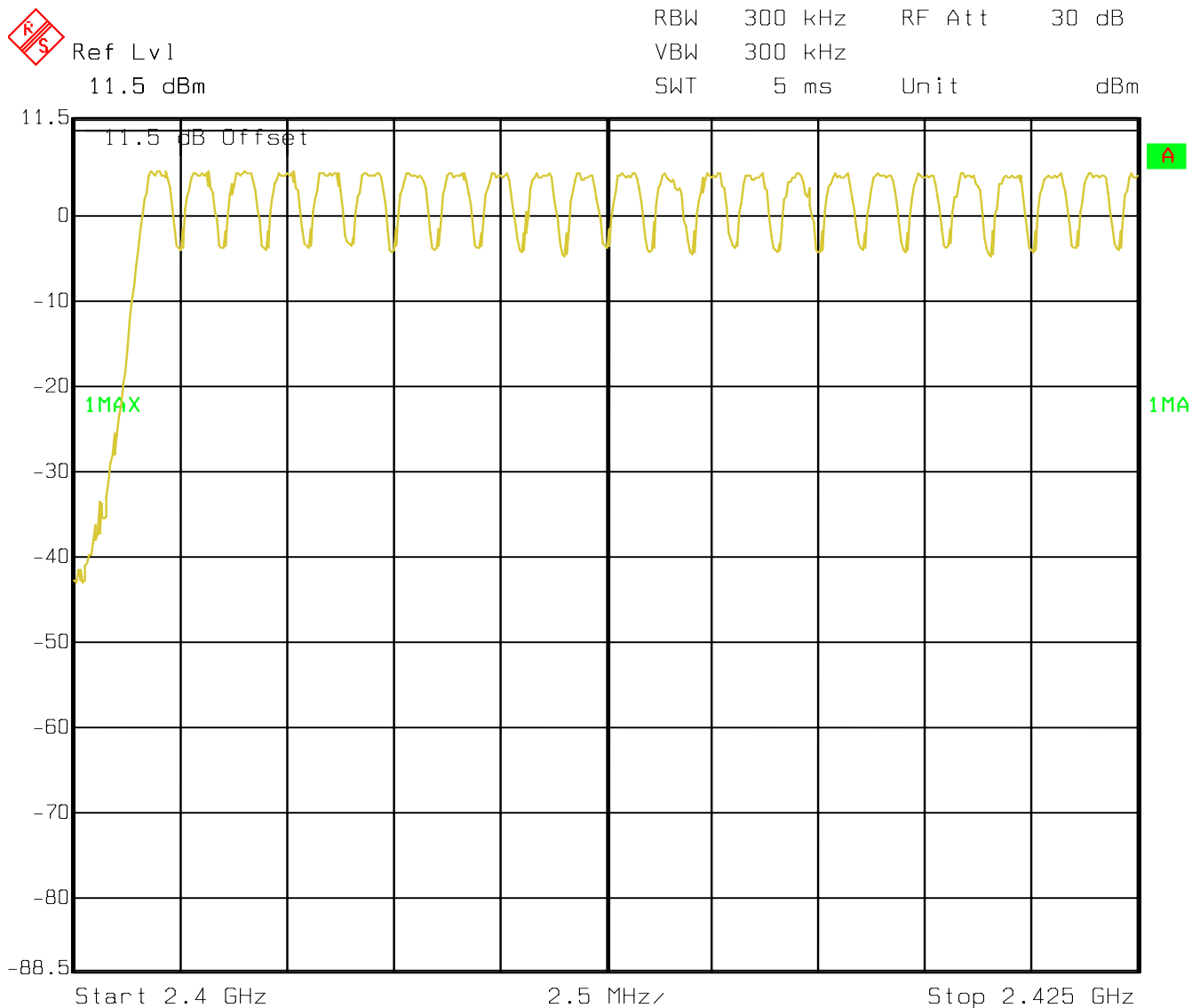
NUMBER OF CHANNELS
> 15

6.4.2 RESULTS:

TEST CONDITIONS		NUMBER OF CHANNELS
T_{nom}(23)°C	V_{nom}VDC	79



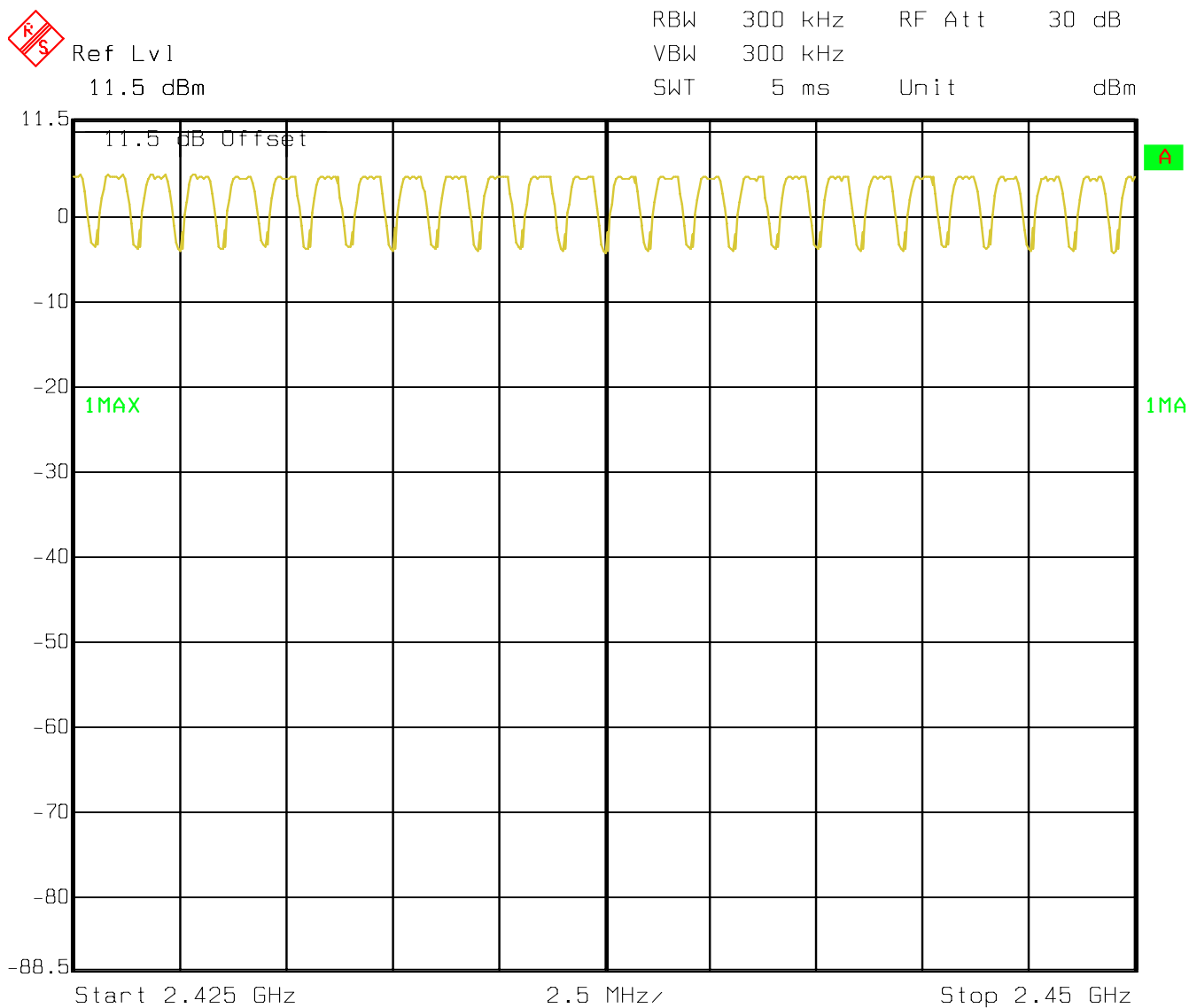
PLOT 1



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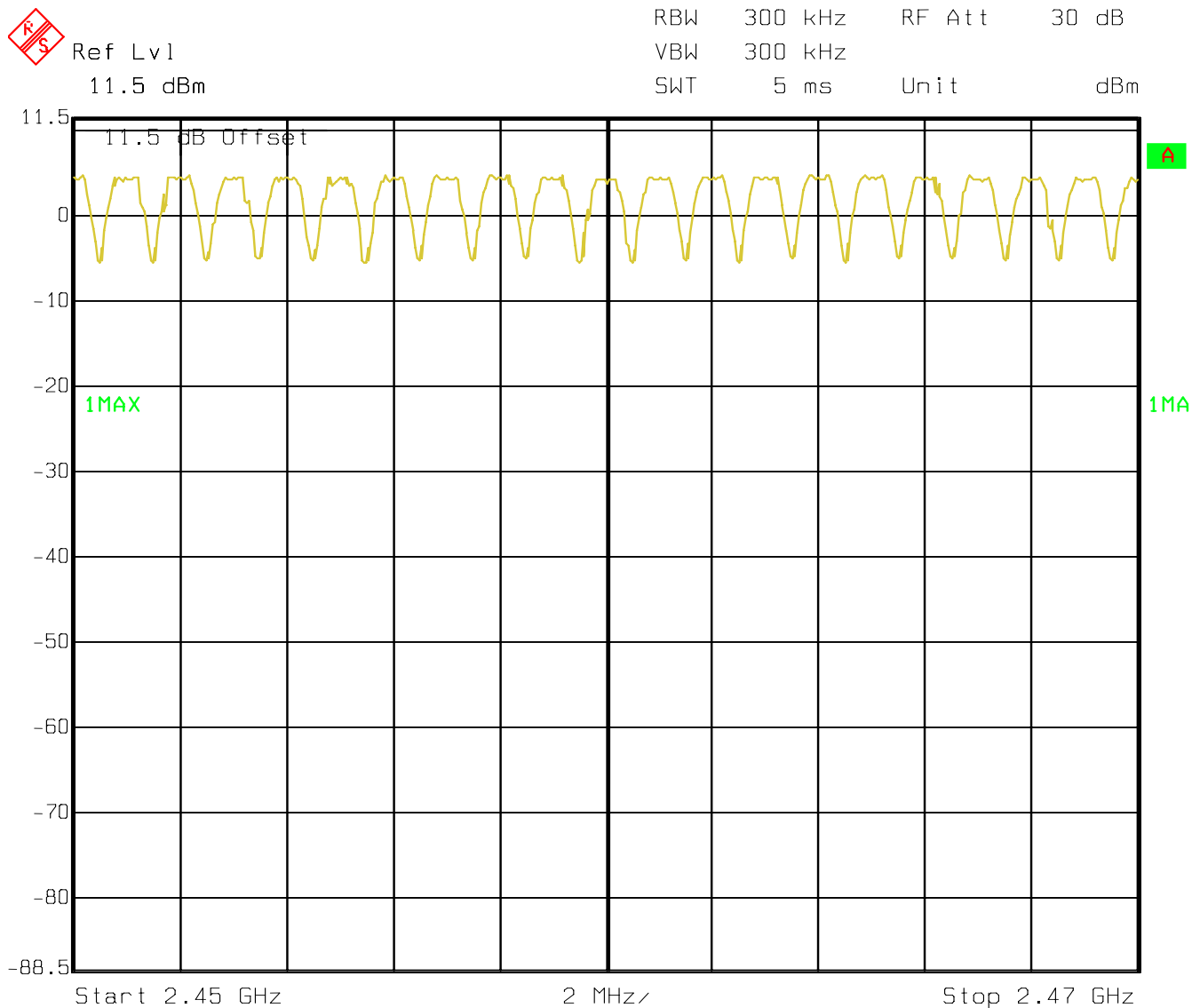
PLOT 2



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PLOT 3



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6.5 TIME OF OCCUPANCY (DWELL TIME)

6.5.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

FREQUENCY RANGE	AVERAGE TIME OF OCCUPANCY PER 31.6 SECONDS (LIMIT)
2400-2483.5	< 0.4 Seconds

6.5.2 RESULTS:

T _{nom} (23)°C	V _{nom} VDC
-------------------------	----------------------

For Bluetooth devices:

The dwell time of 0.4 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is as follows:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6 s

Example for a DH1 packet (with a maximum length of one time slot)

Dwell time = 625 μs * 1600 1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots)

Dwell time = 5 * 625 μs * 1600 * 1/5 * 1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

This is the same for all BT devices and therefore all BT devices satisfy FCC requirement on time of occupancy (dwell time).



6.6 CONDUCTED SPURIOUS EMISSION

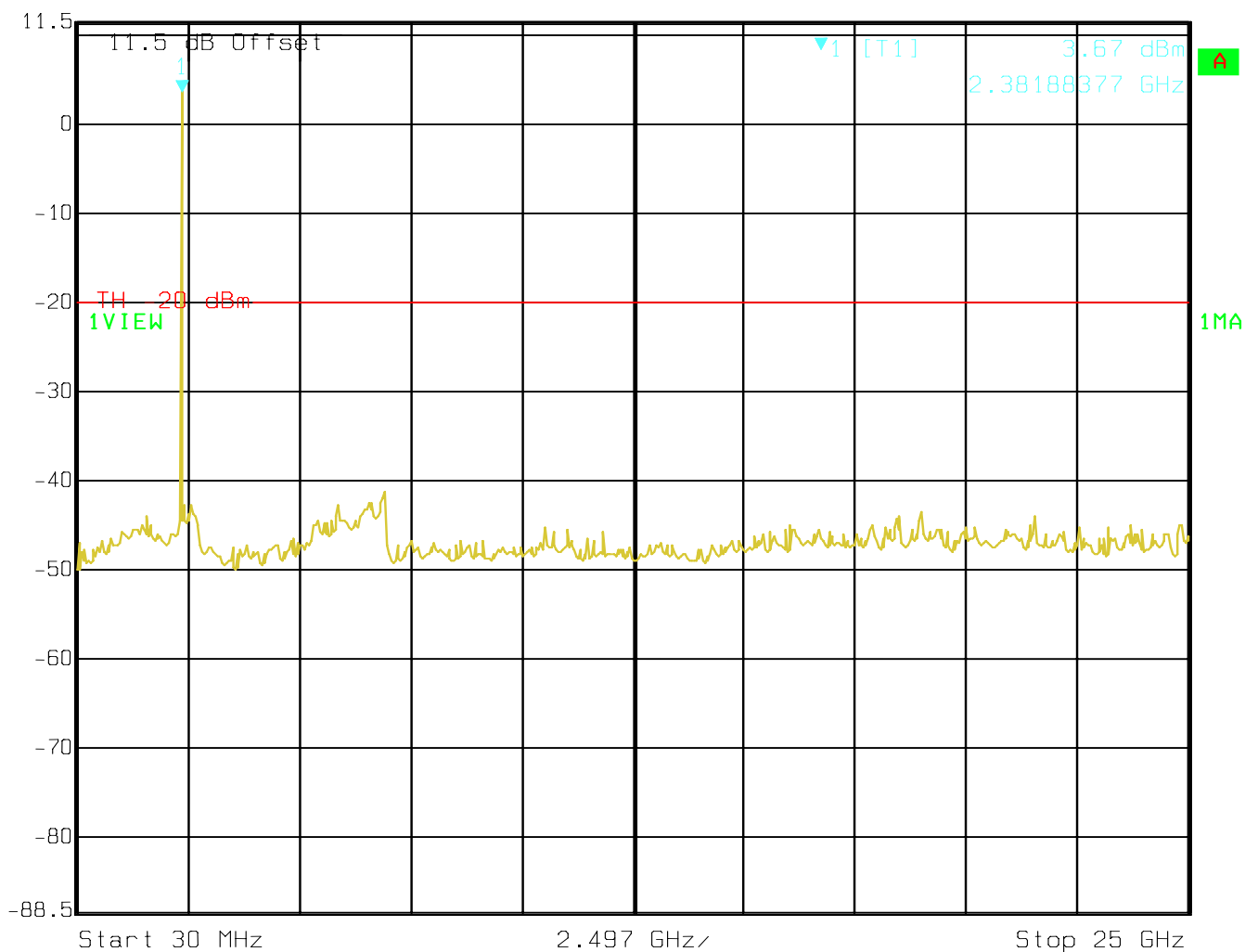
6.6.1 LIMIT SUB CLAUSE § 15.247 (d)

FREQUENCY RANGE	limit
30M-25GHz	-20dBc

6.6.2 RESULTS: Tnom(23)°C VnomVDC

(2402MHz)

⚠ Marker 1 [T1] RBW 100 kHz RF Att 30 dB
 Ref Lvl 3.67 dBm VBW 300 kHz
 11.5 dBm 2.38188377 GHz SWT 6.4 s Unit dBm

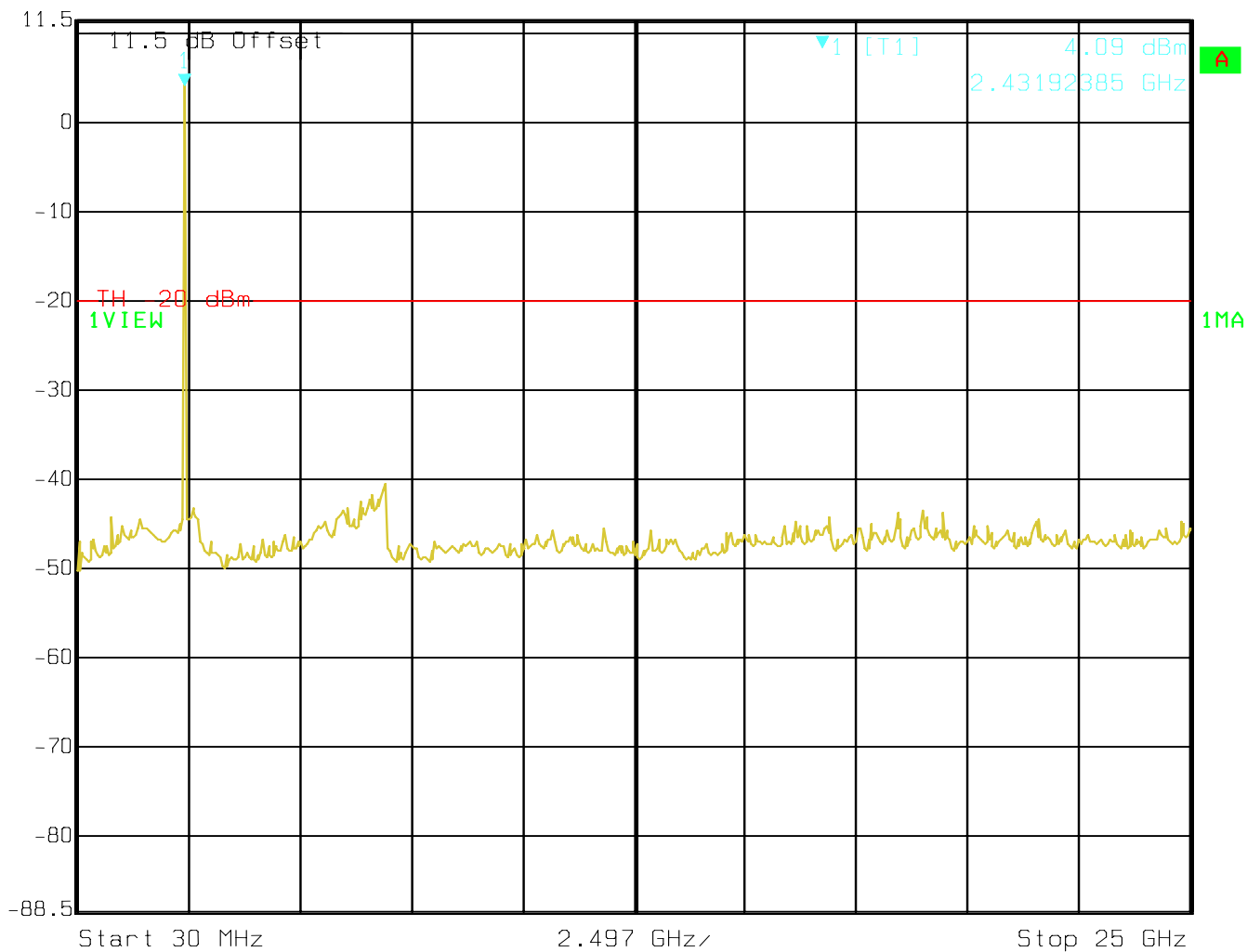


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(2441MHz)

⚠ Marker 1 [T1] RBW 100 kHz RF Att 30 dB
 Ref Lvl 11.5 dBm 4.09 dBm VBW 300 kHz
 11.5 dBm 2.43192385 GHz SWT 6.4 s Unit dBm

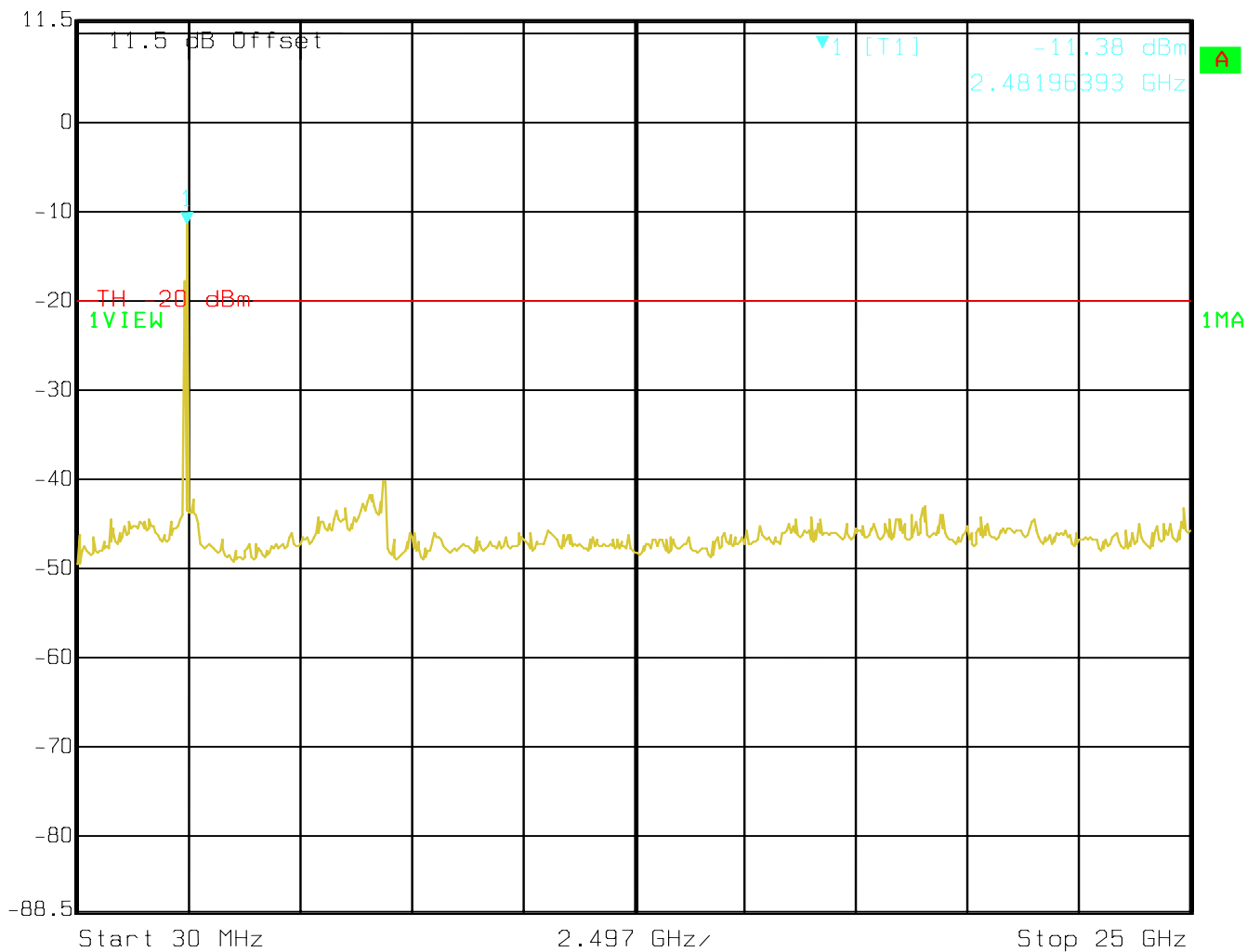


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(2480MHz)

⚠ Marker 1 [T1] RBW 100 kHz RF Att 30 dB
 Ref Lvl 11.5 dBm -11.38 dBm VBW 300 kHz
 2.48196393 GHz SWT 6.4 s Unit dBm



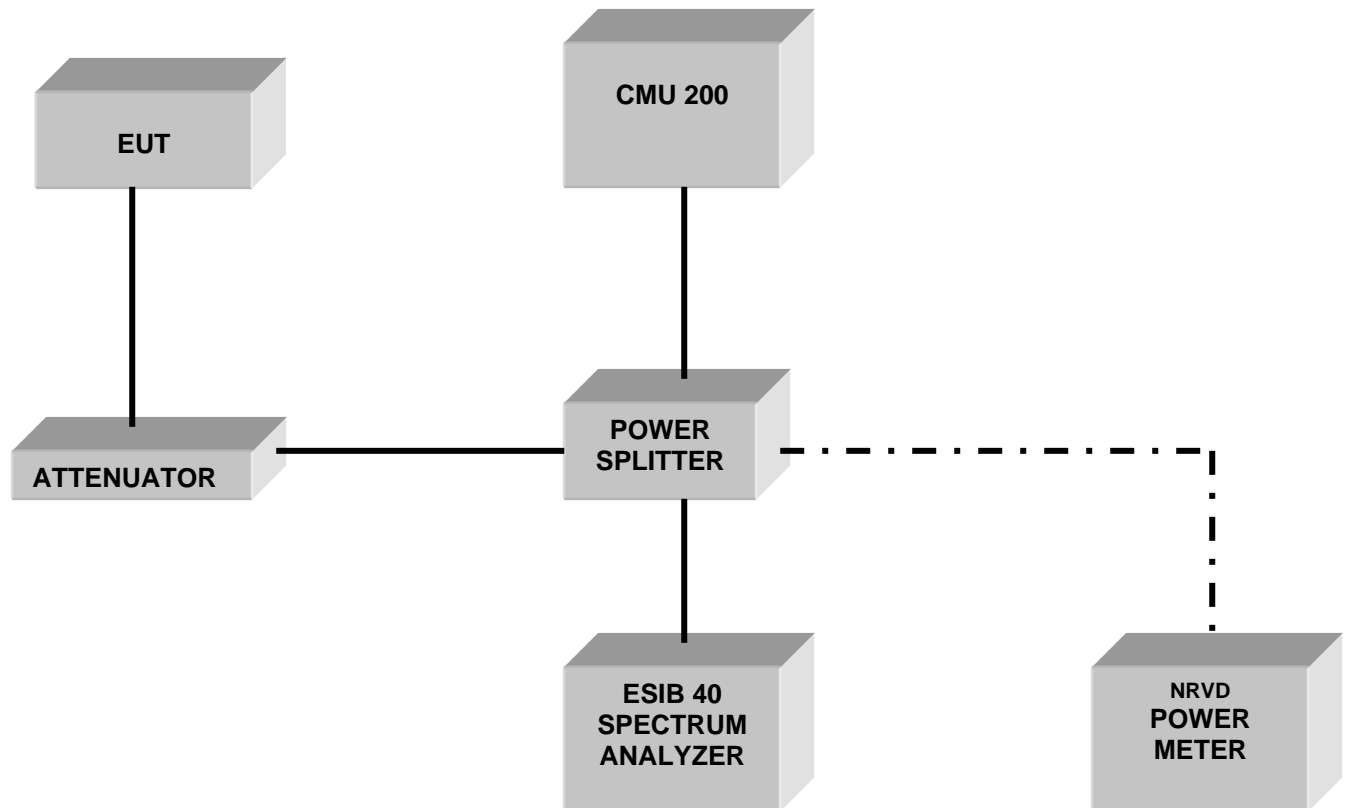
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7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due	Interval
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2008	1 year
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	100017	August 2008	1 year
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011	May 2008	1 year
04	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02	May 2008	1 year
05	Biconilog Antenna	3141	EMCO	0005-1186	June 2008	1 year
06	Horn Antenna (1-18GHz)	SAS-200/571	AH Systems	325	June 2008	1 year
07	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240	June 2008	1 year
08	Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
09	Climatic Chamber	VT4004	Voltsch	G1115	May 2008	1 year
10	High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
11	High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
12	Pre-Amplifier	JS4-00102600	Miteq	00616	May 2008	1 year
13	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807	May 2008	1 year
14	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008	May 2008	1 year
15	Universal Radio Comm. Tester	CMU 200	Rohde & Schwarz	832221/06	May 2008	1 year
16	LISN	ESH3-Z5	Rohde & Schwarz	836679/003	May 2008	1 year
17	Loop Antenna	6512	EMCO	00049838	July 2008	2 years

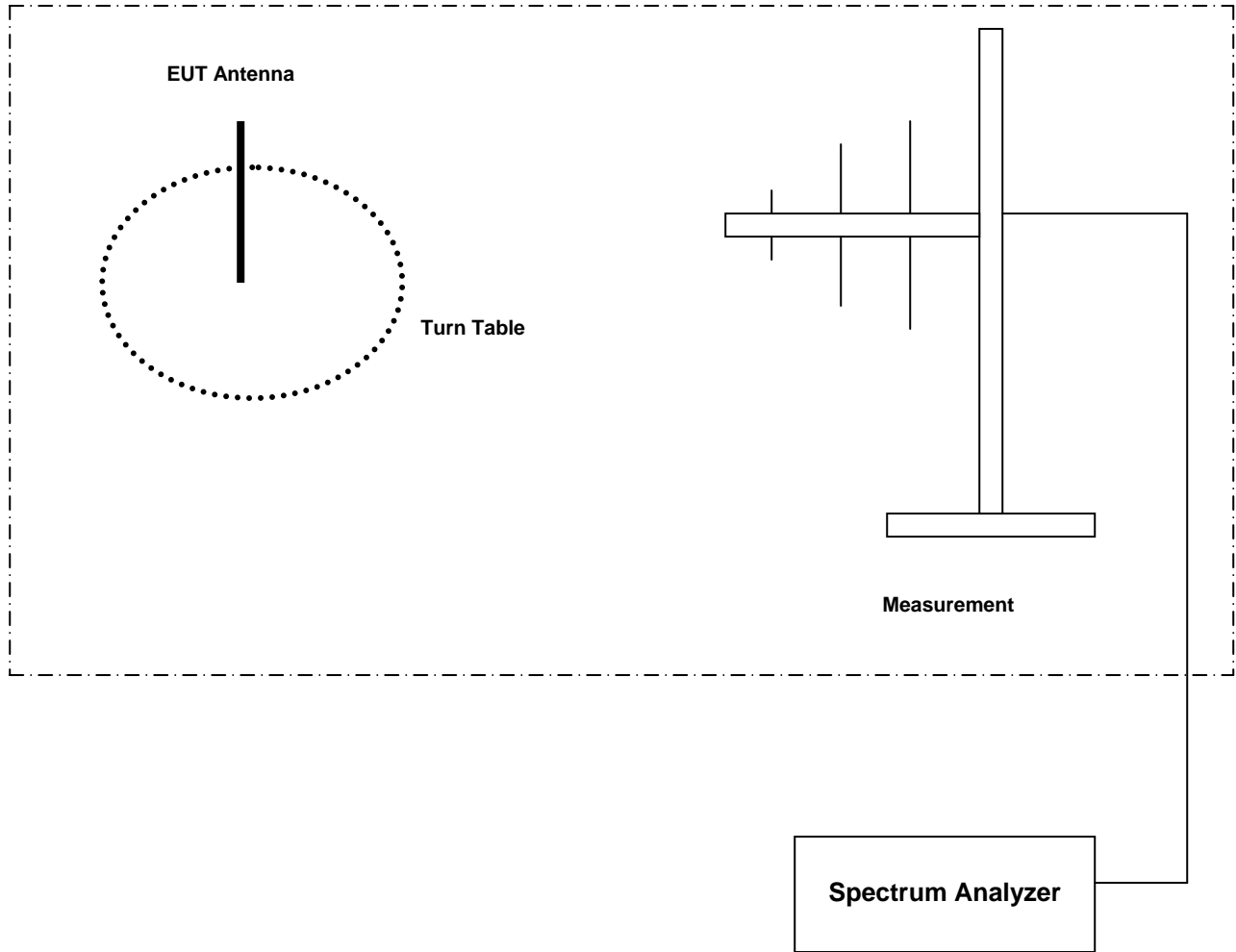
8 BLOCK DIAGRAMS

Conducted Testing



Radiated Testing

ANECHOIC CHAMBER





9 Revision History.

2008-2-29: First Issue

2008-9-3: Rev 1, added measurement settings for 20dB bandwidth and conducted output power.

2008-11-05: Rev1, added power summary for all modulations in section 3.1. Replaces original titled *EMC_HARMA_005_15.247_rev2* and dated 200-9-3.